MARINE REVIEW.

VOL. XVII. CLEVELAND, O., MARCH 3, 1898. No. 9.

Affairs of the Deep Waterways Commission.

A Washington correspondent who is in close touch with affairs of the Deep Waterways Commission writes the Review as follows regarding the appropriation of $225,000 for the work of this commission contained in the sundry civil appropriation bill, which has just passed the house:

"The Cooley estimate for the entire waterway and lake investigation was $600,000, $350,000 of which was for the ship-canal investigation. Congress appropriated $150,000 for the year ending June 30, 1898. The present appropriation of $225,000 is for completion of surveys. It is to be expended during the fiscal year ending June 30, 1899. Possibly a small amount more may be needed in finishing up the final report. The examinations of Niagara river discharge, etc., are practically completed and the observations are now being reduced. The board is now making studies of the regulation problem and expects to report on the problem of regulation of Lake Erie before congress meets next fall. The Niagara ship-canal survey is nearly completed and the results will be reduced and plotted as rapidly as possible, with the expectation of reporting on that portion of the deep waterway project during the present year. The surveys of the Oswego-Oneida-Mohawk route are well advanced, but cannot be completed in time for report this year. Nothing has been done on the St. Lawrence-Champlain route, and cannot until the board is assured that the appropriation will be forthcoming for carrying on the work. As soon as this point is settled, several parties will be put to work on the surveys of that route and it will be prosecuted as late next fall as weather will permit.

"It is understood that a quiet attempt is being made to have the examination and estimate for improving the Erie canal along the lines advocated by Major Symons delegated to the Deep Waterways Commission. This, I think, will be unfortunate if done, and may complicate matters so as to detract greatly from the expected results of the extensive examination that is being made by these engineers. The general government should refrain from touching the Erie canal problem until New York state actually requests such action. No investigation could be made under present conditions without more or less contact with the scandal arising from the recent state work, and this might do much more harm than good. The attempt will likely be made to have the senate amend the appropriation item adopted by the house, so as to provide that the deep waterways engineers shall examine the Erie canal route and prepare plans and estimates for a barge canal."

Insurance Matters.

The work of placing lake insurance, both hull and cargo, has been well under way in the past about the first of March, but this year there is unusual delay. Representatives of the Prime-McCurdy syndicate have returned from England, and it is understood that the general agents of Buffalo, Chicago and Milwaukee have everything arranged for a strong cargo pool, but still there has been no move towards beginning business. The completion of the Inland Lloyds Register is probably awaited by the representatives of the old lake companies, but nothing is said in explanation of the quietness that prevails regarding the probable action of the Chicago syndicate. In the hull pool of the old lake companies the Boston Marine, a very strong concern, is included this year, officers of that company having decided to again return to the lakes for a share of the cargo business. David Vance & Co. of Milwaukee have the agency. It is generally agreed that the inspections for the Inland Lloyd's Register, now nearing completion, have been very carefully conducted by new men under the direction of Capt. A. B. Drake, and that the revision will put vessels on their merits more so than they have been; as far as this register is concerned, in a great number of years. The extensive work involved in the preparation of the Great Lakes Register (Chicago syndicate book) still goes on with as much attention to detail as would be expected if the publishers were certain of securing every dollar's worth of insurance that is to be placed on the lakes for a great many years to come. Mr. F. P. Gordon, representing Johnson & Higgins, was in Cleveland a few days ago, and is quoted as saying that his firm has already completed arrangements that give them assurance of continuing the large line of business which they had with leading vessel-owning companies last year.

Not to Take Work from Wrecking Companies.

Editor Marine Review:—Replying to your inquiry of the 11th ultimo, asking for information as to the recent order requiring revenue cutters to assist vessels in distress, with the view of publishing the same for the information of managers of wrecking companies on the lakes, I have to say that it was not the intention of the order referred to that vessels of the service should be required to assist vessels in distress where other means are available, except where an excessive price might be charged for the service desired, in which event the commanding officer of the cutter would be justified in assisting the vessel. The order applies more particularly to vessels on the Atlantic and Pacific coasts, as the lake vessels are laid up during the winter months and are not called upon to render assistance as frequently as those stationed on the coasts referred to.

C. F. SHOEMAKER,
Captain Revenue Cutter Service,
Chief of Division.

Washington, D. C., March 1, 1897.

Samuel F. Leopold, president of the Lake Michigan & Lake Superior Transportation Co. since its founding forty years ago, and largely interested in copper mines in Northern Michigan, died at his home in Chicago on Saturday last.

Mr. Carnegie's Suggestion to Ship Builders.

"If I were a younger man," says Andrew Carnegie, "or rather, if I did not belong to a concern so enterprising as to employ all my capital and give me a pleasurable occupation watching over its progress and success, I should be greatly inclined to enter upon the building of ships somewhere near New York harbor." Mr. Carnegie is so firmly of the opinion that a ship yard in New York could now compete with ship yards of the world that he writes an enthusiastic letter on the subject from Cannes, France, to the Iron Trade Review of Cleveland. Cheap material is the basis of his argument, and he adds that the cost of material will be still further reduced when it can be moved over his railway from Pittsburg to Conneaut on Lake Erie and thence by canal boats through the enlarged Erie canal. Mr. Carnegie suggests the Hudson, East river, or lower bay near New York as locations for the proposed yard and then discusses the subject as follows:

"The prices paid for steel by British and German ship yards are so much higher than ship builders in New York would be required to pay that the difference would make, in itself, an excellent profit. Plates are worth about $22 or $23 per ton in New York. The quoted price at Glasgow is nearly $30. Other prices are in proportion and all the woodwork of ships is also much cheaper with us. If a yard were built today with the newest appliances, the total cost of labor, even at much higher wages, would be less than in any ship yard I know of, either in Britain or Germany.

"I name near New York as the best for several reasons: 1. A ship yard there would get repair work, which is always profitable. 2. A dry dock could be part of the equipment, which would also be highly profitable. 3. Two years hence the cost of transport upon steel delivered at the ship yard at New York from Pittsburg, the cheapest market for steel in the world, will not exceed $1 per ton, via Conneaut and the deepened Erie canal. Indeed it will be less, since it will cost nothing to send steel to Conneaut in cars which otherwise must return to the lake empty for ore. The present seaboard ship yards are so usefully occupied with domestic business that they cannot give foreign business proper attention. The New York yard should be constructed on a larger scale and with special reference to the foreign demand.

"I am satisfied that the United States can readily regain the supremacy in ship building it had when wooden ships were in vogue. It only needs an enterprising western ship building concern to establish a yard near New York and manage it with the skill and energy which have characterized those on the lakes. This is the only prominent department of manufacturing in which our country is behind, and it is one in which it easily can obtain front rank. It would justify steel manufacturers to guarantee to such a ship building concern a continuance of the present extremely low rates upon steel for a term of years, and also that steel of all kinds and armor and guns should always be furnished at the lowest price paid by European ship builders. But there is nothing to fear from the prices of steel, for these henceforth are to rule lower in our country than in any country of Europe. It will not be long before a large portion of its steel supply must be drawn by Europe from the United States.

"If I were a younger man, or rather, if I did not belong to a concern so enterprising as to employ all my capital and give me a pleasurable occupation watching over its progress and success, I should be greatly inclined to enter upon the building of ships somewhere near New York harbor. There would be no warships or Atlantic liners open for bids in any part of the world which the New York yard would not have something to say about. Every needed element is present for regaining our supremacy as the principal ship building country. Surely some one of the successful lake concerns will consider the advisability of establishing a branch yard near New York—a branch which I predict would very soon grow to many times the capacity of the original works, and give a much higher return upon capital, besides rendering its originator famous."

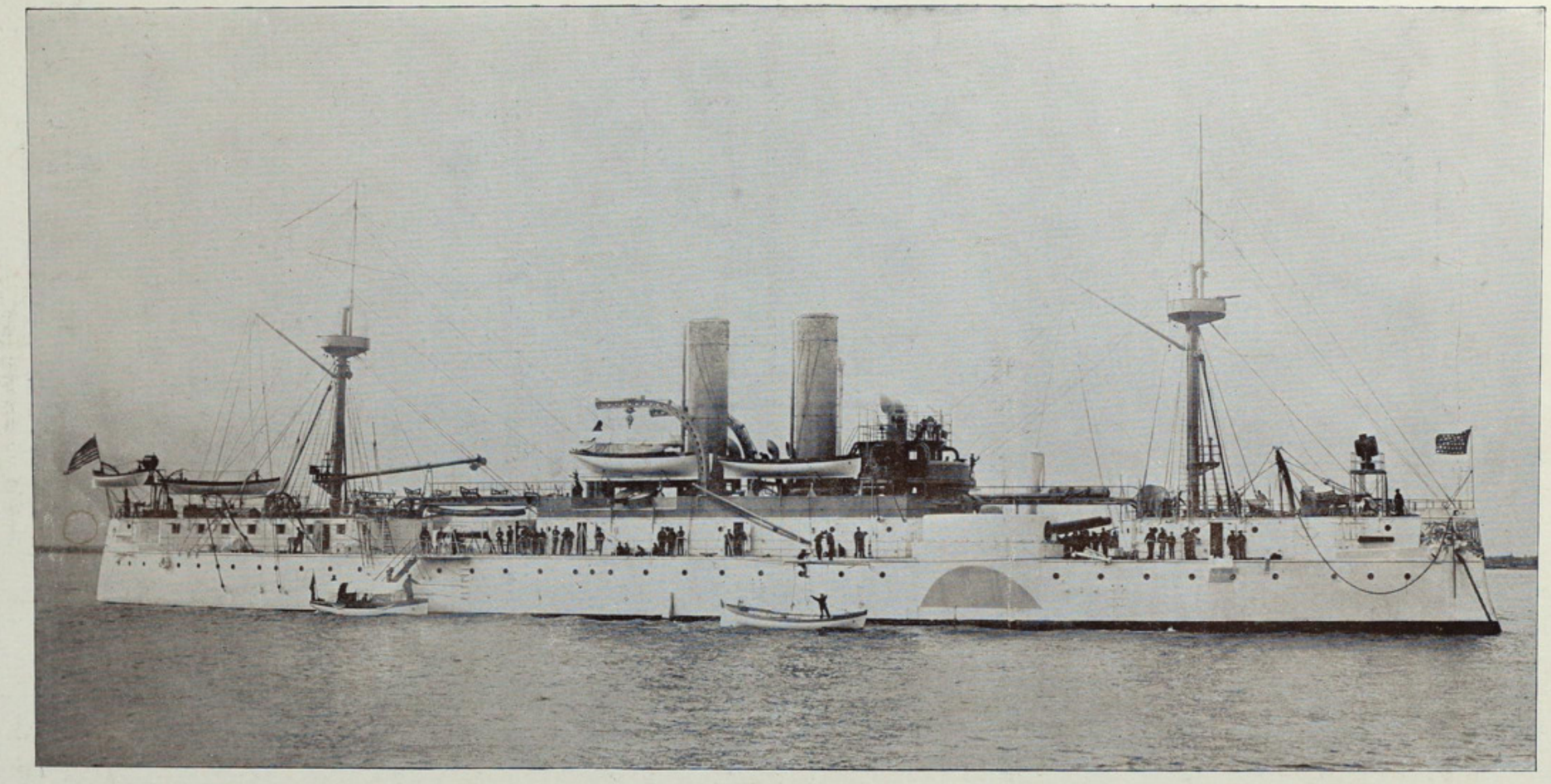
Sale of Ore Still Delayed.

A few small sales of non-Bessemer ore have been made, but it is again announced that the association of Bessemer producers is delayed in quoting prices and will probably not take up dealings with furnace men until the latter part of next week. Vessel men in Cleveland are hoping that the interests of the ore companies in vessels will cause them to offer 70 cents on season ore charters and thus cause the great bulk of 1898 ore to be covered by lake freight immediately after sales are made, but the ore dealers are not disposed to commit themselves in this regard.

Reports from executive officials of the Lumber Carriers' Association are to the effect that owners of lumber vessels are signing the Detroit agreement quite generally, and there is every reason to expect that the organization will be in strong working form within the next two weeks. The executive committee may be able to perfect the organization without calling another general meeting, but a meeting is favored by many of the members, as it is thought that a full expression of confidence in the scheme after signatures have been secured would tend to strengthen the association.

Although the details are not given out, the reported purchase of the entire property of the Carrie Furnace Co. at Rankin, Pa., by the Carnegie Steel Co. has been officially confirmed. It is thought that the product of these furnaces, about 4,000 tons weekly, will practically care for the present shortage of furnace capacity in the works of the Carnegie company.

Fifteen Sanduskians will be interested in the side-wheel steamer that is to be built by the Detroit Dry Dock Co. for service between Erie and Buffalo.



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Supplement to Marine Review, Cleveland, O., March 3, 1898. Vol. 17, No. 9.

U. S. BATTLE-SHIP MAINE.

Keel laid Oct. 17, 1888; launched Nov. 18, 1890; commissioned Sept. 17, 1895.
Destroyed by an explosion in Havana Harbor, February 15, 1898.

DIMENSIONS:

318 feet load water line.
57 " extreme breadth.
21½ " mean draft.
6,682 tons displacement.
$2,500,000 cost of hull and machinery.
Hull built at Brooklyn Navy Yard.

POWER:

Twin-screw, triple expansion engines,
Cylinders, 35½, 57, 88 by 36 in. stroke.
Boilers, eight single ended 10 by 14 ft. 8 in.
Total horse-power, 9,293; speed, 17.45 knots.
Engines built by Quintard Iron Works.

CONSTRUCTION OF LAKE STEAMERS.

A PAPER DEALING WITH RECENT DESIGNS.—PREPARED BY MR. R. L. NEWMAN GENERAL MANAGER OF THE GLOBE IRON WORKS.

At a recent meeting of the Civil Engineers' Club of Cleveland, Mr. R. L. Newman of the Globe Iron Works Co. presented a paper that has occasioned considerable comment, principally on account of the very positive way in which Mr. Newman declares that some steel vessels on

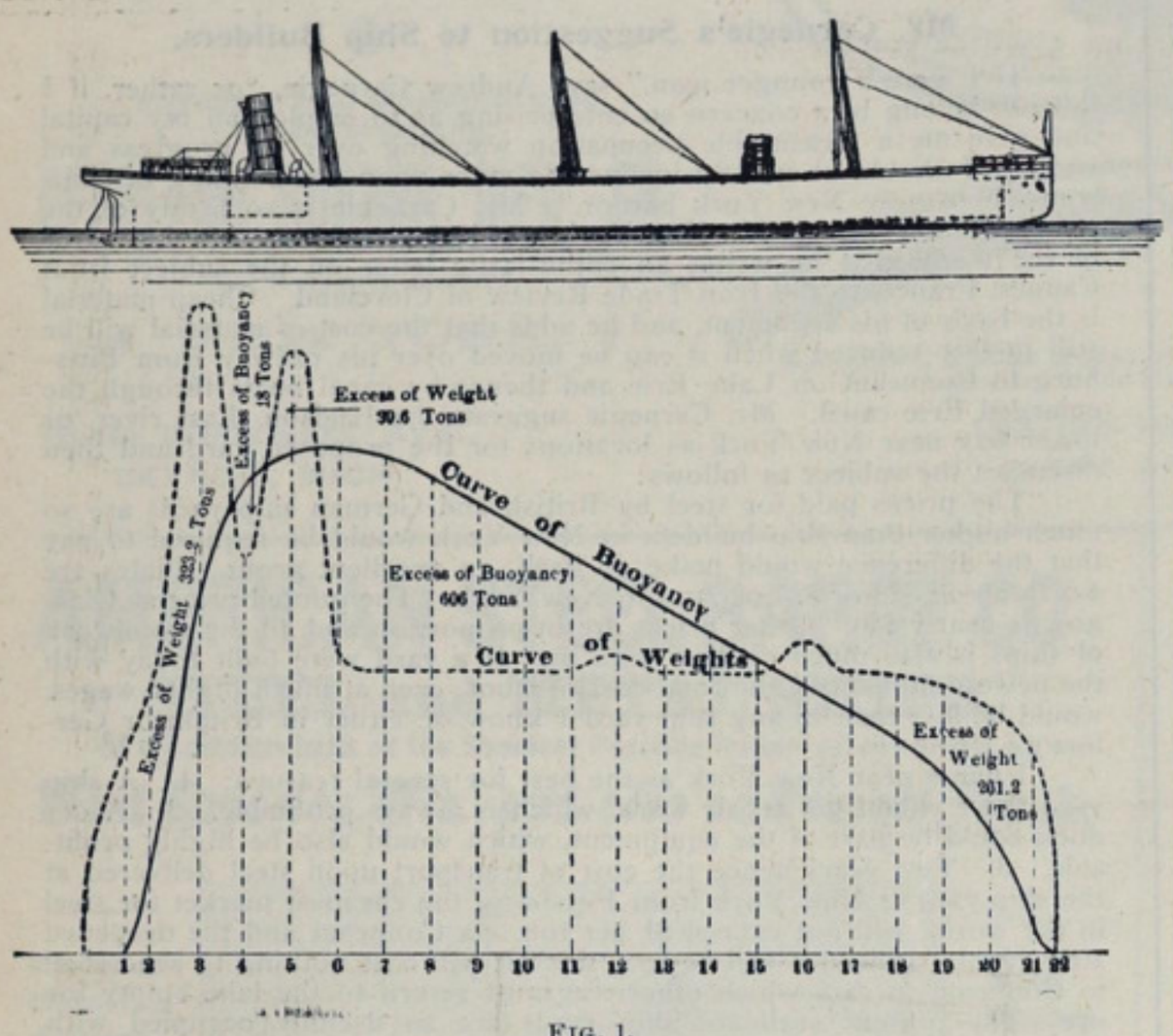
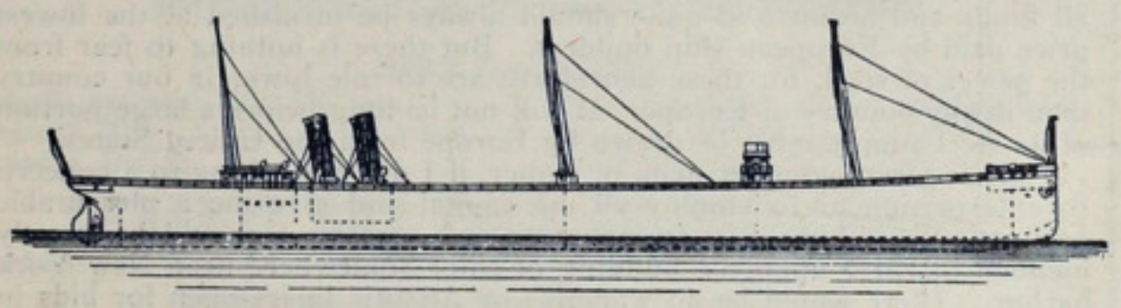

Excess of Weight 323.2 Tons
Excess of Buoyancy 18 Tons
Excess of Weight 30.6 Tons
Curve of Buoyancy
Excess of Buoyancy 606 Tons
Curve of Weights
Excess of Weight 261.2 Tons
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

FIG. 1.

the lakes are structurally weak, and that a large expenditure will be required at some time in the near future to strengthen them. With the exception of a short introduction, Mr. Newman's paper is as follows:

A study of the stresses to which a ship may be subjected is most appropriate just now, as we shall, in a very few months, witness the advent of several fresh-water leviathans of great length. The demands are at present for boats of the largest practical dimensions, limited only by the tortuous channels of the connecting straits and the facilities obtainable at the ports of entry. We are nearing the day when we shall see steamships nearly 500 feet long, bringing down, every trip, over 7,000



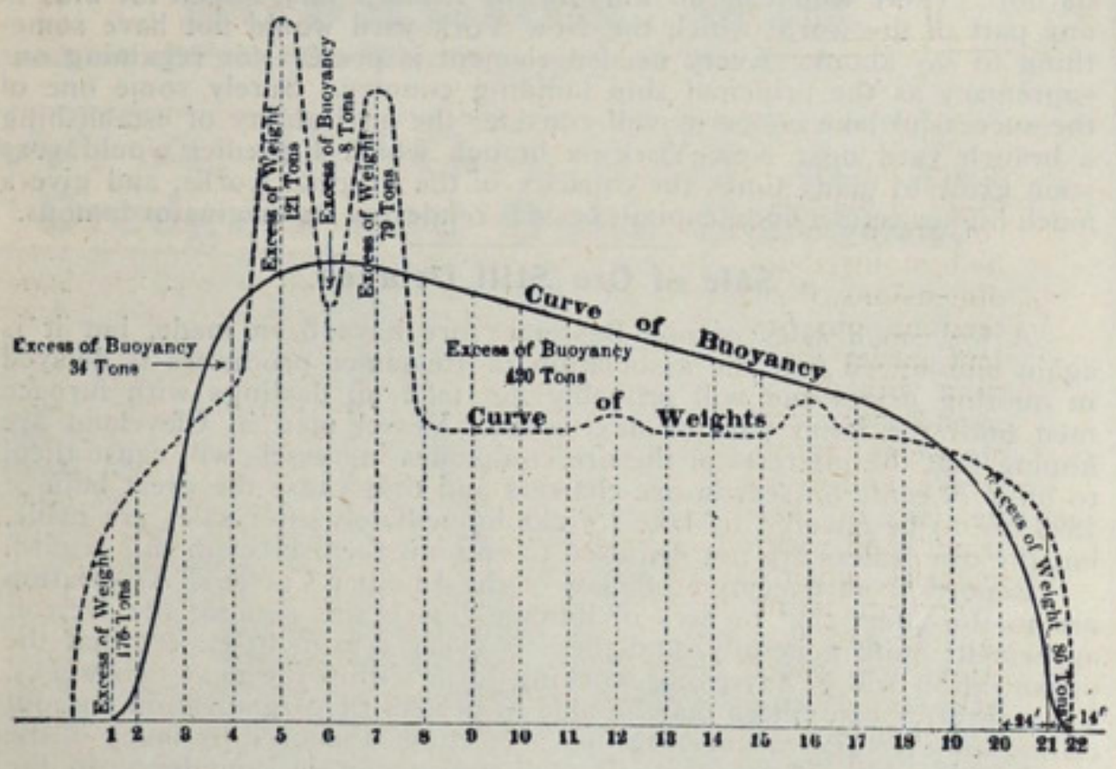

Excess of Weight 121 Tons
Excess of Buoyancy 8 Tons
Excess of Weight 79 Tons
Excess of Buoyancy 34 Tons
Curve of Buoyancy
Excess of Buoyancy 420 Tons
Curve of Weights
Excess of Weight 176 Tons
Excess of Weight 80 Tons
24'
14'
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

FIG. 2.

gross tons of ore, and towing a consort having a similar carrying capacity, but of not quite the same lineal dimensions. The naval architect has therefore to rise to the occasion and satisfy these demands in such a manner that the undertaking will bring credit to himself and to the owner. While providing ample strength, he must also have in view the necessity of not overburdening the boat with material. I remember well a remark made to me by a very celebrated engineer, Mr. A. E. Seaton, some ten years ago, when I had the nominal charge of his drawing office. He remarked to me (over some work I was doing): "Any man can build an engine if he is allowed to put in as much material as he likes; but the engineer of today is the trained man who can build the best engine on the least quantity of material." I know of no expression more appropriate than this to be applied to the ships of today. There are many builders who are certainly building light ships, but are they such as redound to their credit and bring honorable mention to their firms? I regret to state that I believe that there are many boats now floating on the great lakes, built to satisfy the demands of the owner for great carrying capacity, in which the material is distributed in a far from efficient manner; and it will be only a matter of time when, owing to the intense working of the spar decks of these boats, the fatigue limit of the material will have been reached; and woe betide the owner who may have to pay the cost of stiffening the same! It is my firm belief that with a better distribution of material we can obtain excellent results from our ships on a reasonable amount of material, and I will endeavor to point out the little that has been done in this direction.

We all certainly appreciate the structural difficulty to be encountered when we increase the length of our present lake freight from 432 to 475

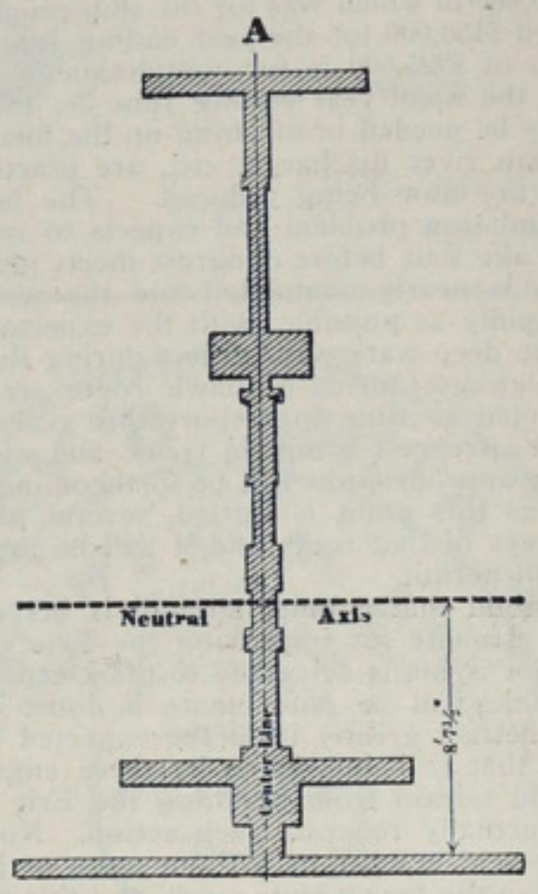


FIG. 3. EQUIVALENT GIRDER. DESIGN A.

or 500 feet, yet this feat will shortly become an accomplished fact. The two most important points to decide are (1) the position of machinery, and (2) the scantlings; or, in other words, the midship sections, that give the best possible distribution of material. Figs. 1 and 2 illustrate a ship lying at rest in still water, unloaded. She has, therefore, to support only her own weight and that of her machinery. In Fig. 1 the machinery is placed aft; in Fig. 2 it is placed somewhat forward. Each figure shows two curves—the curve of weight and the curve of buoyancy. Owing to lack of time I have been unable to prepare similar curves for boats ballasted and loaded. In Fig. 1, between ordinates 1 and 6, the curve of weight is in excess of the curve of buoyancy to the amount of about 345 tons; that is to say, this weight of 345 tons must receive support from some other part of the ship than that immediately under it. Between ordinates 6 and 15 the curve of buoyancy is considerably above the curve of weight, but between ordinates 15 and 22 the weight rises again in

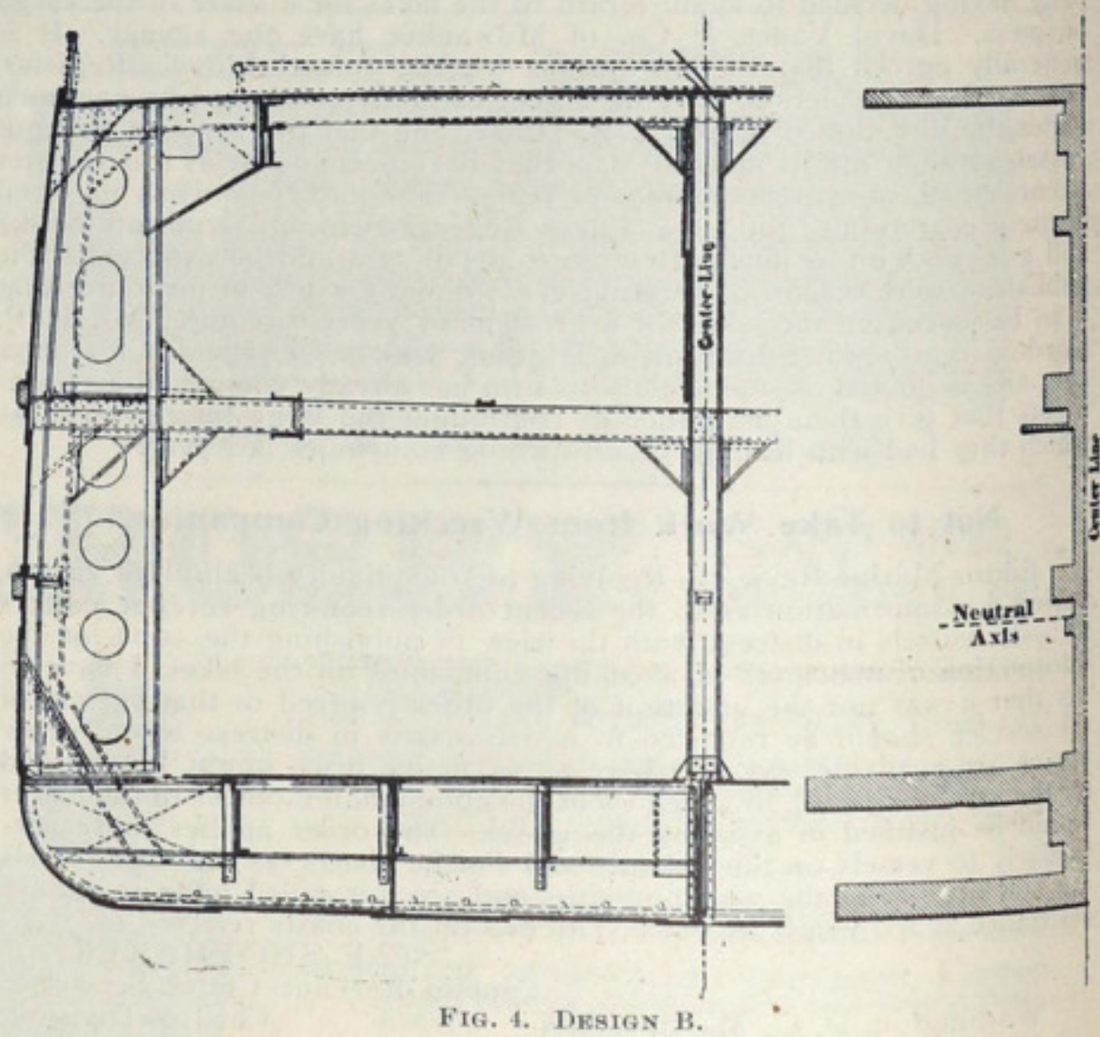


FIG. 4. DESIGN B.

excess of the buoyancy to the extent of 261.2 tons. Our ship is simply a beam, supported amidships and weighted near the bow and near the stern with the weights of 261.2 and 345 tons, respectively. The result is a very severe bending moment in the area representing the excess of buoyancy. In Fig. 2 the excess weight aft is 334 tons, and the excess

weight forward is only 86 tons, while the excess of buoyancy amidships is only 420 tons. In Fig. 1 the center of gravity of the overhanging weight is somewhere about ordinate 3, while in Fig. 2 it is a little abaft of ordinate 5, so that, besides reducing the unsupported weight, we have practically shortened our beam and consequently have reduced the bending moment around the center of gravity of the area representing the excess of buoyancy. Fig. 2 gives, therefore, a much better distribution than Fig. 1, which represents the old practice of placing the machinery in the stern, and it is also my belief that when the boat represented by Fig 2 is ballasted the excessive vibration, or spring-board action observed in our modern freighters, will be no greater than in those already existing,

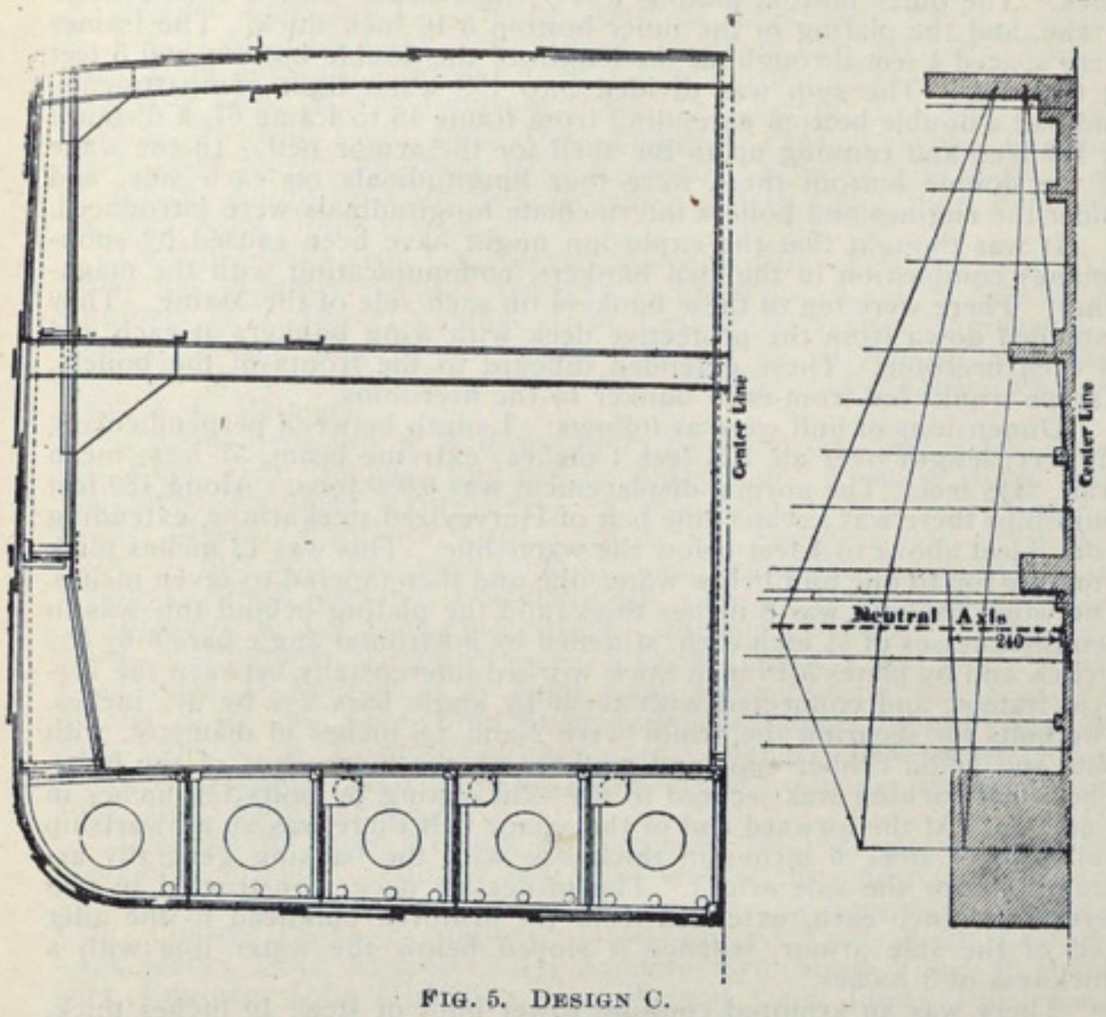


FIG. 5. DESIGN C.

notwithstanding her excessive length. I think, also, that this could have been still further improved upon had the machinery been placed further amidships; but it seemed advisable to stop where we did, in view of the difficulties that might possibly occur in handling the cargo over the tunnel which protects the line shafting. It was our intention to put a raised platform over the tunnel right across the ship, to facilitate, as far as possible, the handling of cargo. This, of course, would raise somewhat the center of gravity of the cargo placed aft.

I have here shown that, although a boat may be unloaded and lying at rest, it is possible for her to be subjected to a very severe stress, and this stress might be either what is generally known as a "hogging" or as a "sagging" stress. In this particular case it happens to be a "hogging" stress; but it is possible, under certain conditions, to so distribute our

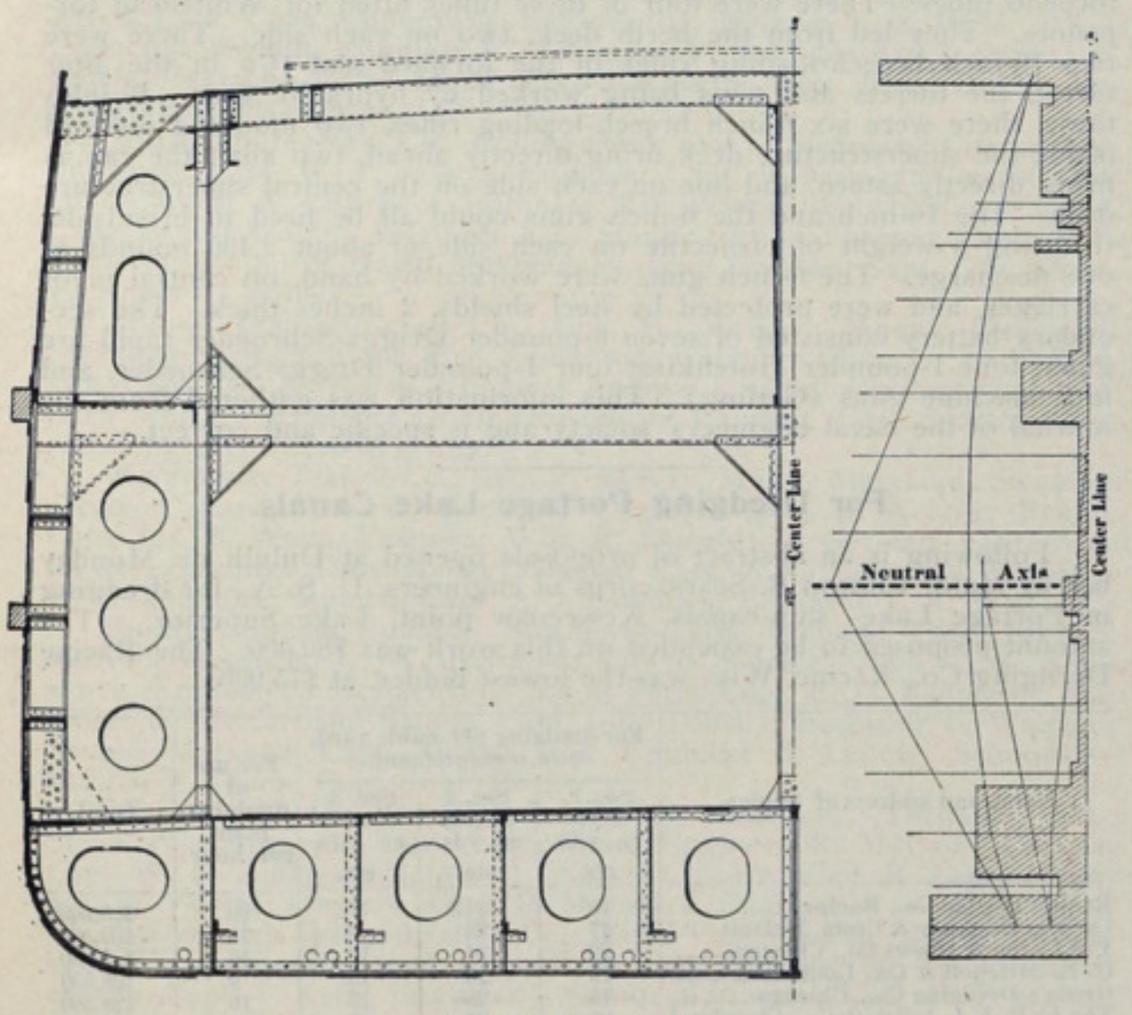


FIG. 6. DESIGN D.

weights, etc., that the boat will be subjected to a "sagging" stress, especially in heavily armored warships. Such a boat, loaded, and riding through a series of waves, would, in all probability, during a period of a few seconds and through each foot of its length, be subjected to a severe hogging and bending strain, due to the condition of support on the wave crest. The wave conditions on our great lakes are very difficult to approximate; at least, I have found it so during my endeavors to obtain reliable information concerning them.

Fig. 3, design A, shows the "equivalent girder" for a given ship; that is to say, the material of the midship section is supposed to be collected and arranged in such form as will enable us to approximate the strength of the ship treated as a girder. The ship, whose equivalent girder is shown in Fig. 3, is one of several floating today on the great lakes. Figs. 4, 5, 6 and 7 show the midship sections and the "equivalent girders" of four vessels, as follows: 4-B, schooners Sidney G. Thomas and Antrim; 5-C, steamship shown in Fig. 1; 6-D, tow barge, consort to steamer shown in Fig. 1; 7-E, steamship shown in Fig. 2. The Thomas and the Antrim were built last spring by the Globe Iron Works Co.—the Thomas for the Bessemer Steamship Co., and the Antrim for the American Transportation Co. I consider the equivalent girder of the Thomas as embodying a great step in advance of her predecessors. The boat represented in Fig. 5 is over 400 feet long, and has been steaming on the great lakes for a couple of years. In the table published herewith we find the moment of inertia of the several midship sections, and in comparing the bending moment of the latter we notice that, as we have progressed, we have so arranged our material that with each step the position of the neutral axis has been raised considerably. The benefit of this is apparent to all. On looking at the earlier equivalent girders, the point that first strikes the observer is the very bad distribution of material. In analyzing a ship by this method, the first thing we should naturally do would be to map out for ourselves an ideal section to withstand the strains to which a ship is subjected: and I think our ideal would be the H section which is used so extensively for girders. Here we have symmetrical top and bottom members, practically uniform in section and securely attached or tied to one another by the center web. Now, if we compare the equivalent girder of Fig. 3, design A, with this ideal girder, we find that there is no attempt to obtain equal sections for these two members, but that the bottom flange is excessively overburdened with material, which consequently depresses the neutral axis of the whole section. In the equivalent girder of Fig. 4, design B, we note that, although the neutral axis has risen somewhat, we have, nevertheless, a girder far from symmetrical. In Fig. 5, design C, we note a retrograde step. The neutral axis has not quite fallen back to the level of that in Fig. 3, design A, but very nearly so.

In the equivalent girders of Figs. 6 and 7, designs D and E, we notice a considerable improvement over the foregoing sections, and these represent what I believe to be the best and latest steps taken in this direction.

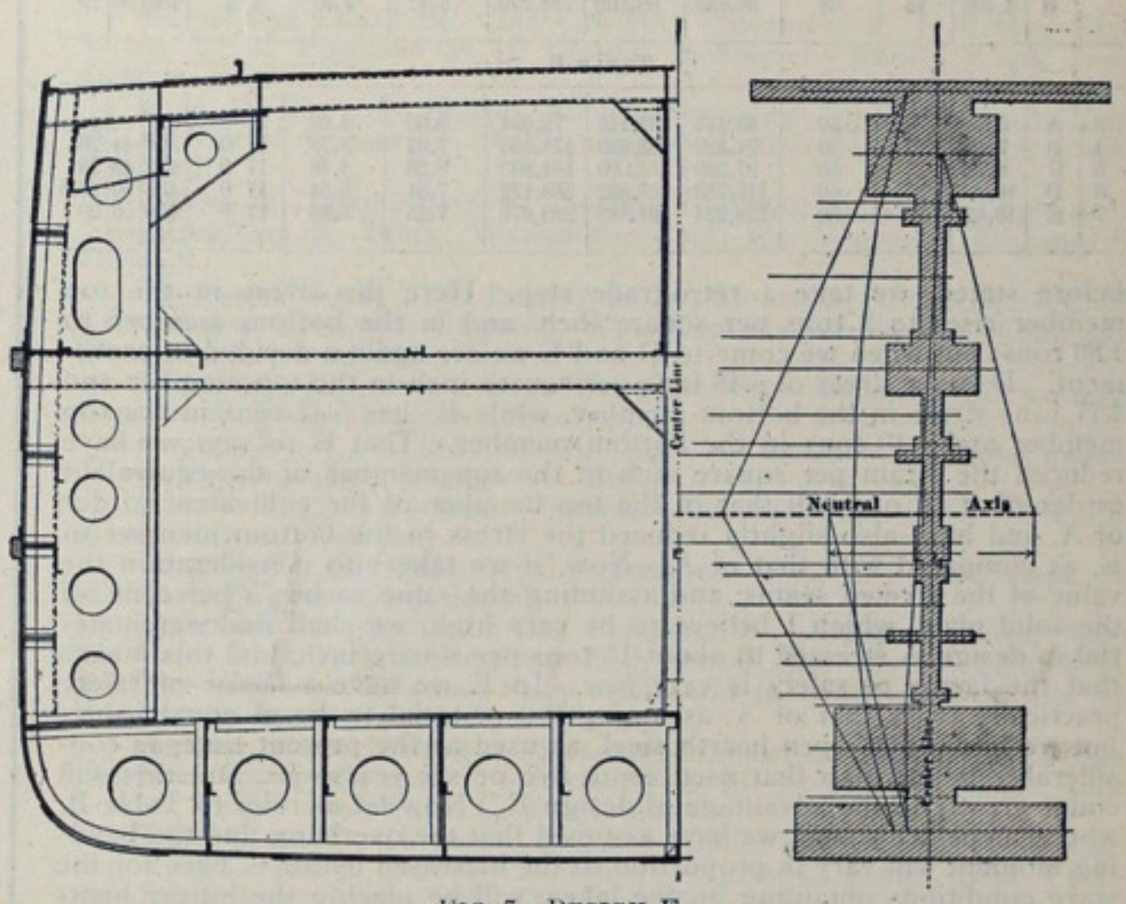


FIG. 7. DESIGN E.

The top and bottom members of these beams show a more nearly equal distribution of material, and consequently quite a considerable rise in the center of gravity of their sections. The boats showing what I believe to be the best distribution of material have less material, relatively to their lineal dimensions, than those first mentioned. In endeavoring to obtain these sections, our first thought was that Fig. 3, design A, showed an equivalent girder that was practically all bottom and altogether out of proportion with the top chord, the latter represented by the spar deck stringer and sheer strake. We have endeavored to take out quite a considerable weight from the tank, and have added this to spar deck and sheer strake, and in the shape of shelf plates under the spar deck beams and one, two or three longitudinal stringers running under the spar deck beams, and secured by intercostal plates to the spar deck as well. This material, when assembled, shows a very satisfactory section. It will be very interesting to note that the boats represented by Figs. 6 and 7, designs D and E, have another distinguishing feature—the floors in the bottom are spaced every 2 feet, but the frames, from tank top to spar deck, are spaced 4 feet apart, and are made of a somewhat stronger section of channel than that generally adopted for this purpose. In addition, the top and bottom members are securely tied together by deep web frames, 24 feet apart, and also by 25-inch channel stanchions, 8 feet apart. Immediately under these stanchions are the bilge brackets, also solid, tying the top and bottom members together more securely. Of course, it would be considerably better if we could introduce also a system of diagonal bracing between these channel stanchions; but, inasmuch as this would affect the working of the cargo, it is out of the question. Owing to the increase in the spacing of the frames, the shell plating has not the local support that it had in earlier designs; but, taken as a whole, this structure, complete, is considerably stronger than that of the usual form. Recognizing, however, that the shell plating requires some additional support locally, we have introduced a system of longitudinal intercostals, built up of channel and so arranged that there is never more than a

square piece of plate, 4 feet by 4 feet, unsupported. This channel, when worked into the ship, not only affords local stiffness, but, when properly fitted, can be made very effective and useful for hold stringers; and it will also be noticed that, in each case where we have introduced belt framing, we have also a deep floor rising from the bottom to the top of the tank, and a much heavier channel forming the spar deck beam. This means particularly that the ship, every 24 feet, is held together both vertically and horizontally by a strong and most effective band, making what I believe to be one of the strongest, if not the strongest, midship section as yet on the lakes.

As before stated, in endeavoring to obtain some satisfactory information as to the wave conditions existing on these lakes, I failed to arrive at anything very definite. I have therefore had to assume conditions approximately; but I am satisfied that there are never less than three or four waves under even the shortest ship here illustrated. If this is so, it is fair to assume that all ships will practically, under the worst conditions, overhang a wave crest the same number of feet, and that the bending moment will therefore vary, not directly as the length, but in the ratio of this amount of overhang to the length of the ship. Fearing that some would think this was favoring the latter designs, I have given also a table showing a comparison of these several midship sections, assuming that the aforesaid bending moment would vary directly as the length. In Table A, if we refer to design A, we shall notice that the stress in the top member, under these conditions, amounts to 11.1 tons per square inch, and in the bottom section 5.78 tons per square inch. In design B the 11.1 tons fall to 7 tons, and the 5.78 tons in the bottom member fall to 3.78 tons, which speaks highly for the midship section of B. In C, as

TABLE OF DIMENSIONS AND MOMENTS OF RECENT LAKE VESSELS.

TABLE A.

Fig.	Design.	Displacement, net tons.	Coefficient for wavecrest	Coefficient for wave hollow.	Bend'g moment, foot tons. Wave crest.	Bend'g moment, foot tons. Wave hollow.	Moment of inertia	Stress, tons per square inch. Top member	Stress, tons per square inch. Bottom member	Draft mean. Ft. In.	Keel.	Beam.	M'l'd depth.
3	A	1,600	30	45	53,580	35,720	79,694	11.10	5.78	5 9	.....	...	.....
4	B	1,770	37	50	78,420	52,850	175,555	7.00	3.78	4 7	366	44	26
5	C	2,800	40	60	90,011	60,007	184,803	9.00	4.86	6 0.5	412	48	28
6	D	2,703	43	62	102,166	70,857	268,122	6.48	4.77	5 6	436	50	28.5
7	E	3,400	48	68	98,839	69,769	288,670	5.47	4.40	4 6	455	50	29

TABLE B.

Fig.	Design.	Displacement, net tons.	Coefficient for wavecrest	Coefficient for wave hollow.	Bend'g moment, foot tons. Wave crest.	Bend'g moment, foot tons. Wave hollow.	Moment of inertia	Stress, tons per square inch. Top member	Stress, tons per square inch. Bottom member	Draft mean. Ft. In.	Keel.	Beam.	M'l'd depth.
3	A	5,358	37	50	43,443	32,148	79,694	9.00	4.69	17 0	.....	...	.....
4	B	7,220	37	50	71,420	52,850	175,555	7.02	3.78	17 0	366	44	26
5	C	8,739	37	50	97,309	72,009	184,803	8.26	4.46	17 0	412	48	28
6	D	10,076	37	50	118,733	87,862	268,122	7.54	5.54	17 0	436	50	28.5
7	E	10,427	37	50	128,224	94,885	288,670	7.25	5.88	17 0	455	50	29

before stated, we take a retrograde step. Here the stress in the top member rises to 9 tons per square inch, and in the bottom member to 4.86 tons; but when we come to D and E we see again a decided improvement. D has a stress of 6.48 tons per square inch in the top member and 4.77 tons stress in the bottom member, while E has 5.47 tons in the top member and 4.40 tons in the bottom member. That is to say, we have reduced the strain per square inch in the top member of the equivalent girder of E to one-half that of the top member of the equivalent girder of A, and have also slightly reduced the stress in the bottom member of E, as compared with that of A. Now, if we take into consideration the value of the riveted seams, and assuming the same to be 75 per cent. of the solid plate, which I believe to be very high, we shall find our material in design A stressed to about 15 tons per square inch, and this means that the factor of safety is very low. In E we have a factor of safety practically twice that of A, assuming the material to be of equal value; but we know that open hearth steel, as used at the present time, is considerably better than that used some five or six years ago, and this will count greatly to the advantage of design E. Now let us refer to Table B, where, as before stated, we have assumed that the overhang and the bending moment will vary in proportion to the increased length. This, for the wave conditions obtaining on the lakes, will be placing the longer boats at a most decided disadvantage, compared with the smaller ones; but we find, on referring to the stress per square inch given in the table, that design A has the top and bottom members stressed 9 tons and 4.69 tons, respectively, and E has her top and bottom member stressed 7.25 tons and 5.88 tons, respectively, giving to D and E a decided advantage over those preceding, even under this unfavorable condition of comparison.

We certainly have here some food for reflection. These midship sections represent the practice of several years, and if we can justly come to the conclusion that we have made some little progress, it is certainly gratifying; and I think we are safe in assuming that the later practice represents a step forward. Tables A and B show this very distinctly, and, when we recognize that ship E is 43 feet longer than ship B, 2 feet more beam and 1 foot greater depth of hold, and has only about 100 tons more of material, we can certainly feel that we have made a most decided advance; and it is the ability to give to ship owners these increased dimensions on proportionally smaller weight that renders this undertaking financially successful. The figures given in tables A and B have been worked out on the slide rule; but they are, I believe, fairly accurate.

The Saginaw Bay Towing Association of Bay City is preparing for a busy season towing logs from Georgian bay. Their tug Sweepstakes has been rebuilt during the winter and when completed she will be one of the finest tugs on the lakes. The tug Traveler will have a new fore-and-aft compound engine, built by F. W. Wheeler & Co., and two new boilers and a 14-foot wheel, built by Wickes Bros. of Saginaw. Other tugs in the fleet are also being repaired, and they will all go into commission as soon as navigation opens.

Mr. J. H. Cremer of Cleveland announces that the business of his laboratory will be conducted in the future under the firm name of Cremer & Bicknell. For a number of years past Mr. Bicknell has been a special partner, so that the change is in name only.

United States Battleship Maine.

A supplemental illustration in this issue shows the battleship Maine, destroyed by an explosion in Havana harbor, Feb. 15. She was a second-class battleship and was the largest ship ever constructed in a United States navy yard. Her engines were built by the Quintard Iron Works, New York, at a cost of $735,000. The total cost of hull and machinery, exclusive of armament, was $2,500,000.

Interest centers in the construction of the hull. It was of mild steel, and all of the material used was of domestic manufacture. The outside keel plate was 5/8 inch, the inner plate 1/2 inch, and the vertical keel 1/2 inch thick. The outer bottom plating was 1/2 inch thick, with a double sheer strake, and the plating of the inner bottom 5-16 inch thick. The frames were spaced 4 feet throughout the length of the double bottom and 3 feet at the ends. The ship was divided into 198 water-tight compartments, and had a double bottom extending from frame 18 to frame 67, a distance of 196 feet, and running up to the shelf for the armor belt. In the wake of the double bottom there were four longitudinals on each side, and under the engines and boilers intermediate longitudinals were introduced.

It was thought that the explosion might have been caused by spontaneous combustion in the coal bunkers, communicating with the magazines. There were ten of these bunkers on each side of the Maine. They extended down from the protective deck with wing bunkers at each end of each fireroom. These extended inboard to the fronts of the boilers. Escape trunks led from each bunker to the firerooms.

Dimensions of hull were as follows: Length between perpendiculars, 310 feet; length over all, 324 feet 4 inches; extreme beam, 57 feet; mean draft, 21½ feet. The normal displacement was 6,650 tons. Along 180 feet amidships there was a water-line belt of Harveyized steel armor, extending from 3 feet above to 4 feet below the water line. This was 12 inches thick from the top to one foot below water line, and then tapered to seven inches. The wood backing was 8 inches thick, and the plating behind this was in two thicknesses of 1/2 inch each, stiffened by horizontal angle bars 6 by 3½ inches, and by plates 5-16 inch thick worked intercostally between the vertical frames, and connected with them by angle bars 2½ by 2½ inches. The bolts for securing the armor were 2 and 2.8 inches in diameter, with nuts and India rubber cups and washers on the inner ends of the bolts. The wood backing was secured to the skin plating by bolts 1⅛ inches in diameter. At the forward end of the armor belt there was an athwartship bulkhead of steel, 6 inches in thickness, with the backing generally arranged as for the side armor. The protective deck, constructed in two layers of 1 inch each, extended from the armored bulkhead to the after end of the side armor, whence it sloped below the water line with a thickness of 3 inches.

There was an armored conning tower built of steel, 10 inches thick, elliptical in shape, from which an armored tube, 4½ inches thick, extended down to the armored deck to protect the steering gear, voice tubes, electric wires and connections of the engine room telegraphs. There were two revolving turrets, each fitted for two 10-inch guns, constructed at sufficient height to admit the guns in each turret being fired simultaneously on a line parallel with the center line of the ship, each having an unobstructed fire through an angle of 180 degrees on one side, and through an angle of 64 degrees on the opposite side. The revolving parts of the turrets, and the spaces for working and loading the guns, were protected by a fixed barbette of mild steel armor, 12 inches in thickness, fitted to a wood and steel plate backing and secured by bolts and nuts, as described for the side armor.

It was suggested that dynamite may have been introduced into the torpedo tubes. There were four of these tubes fitted for Whitehead torpedoes. They led from the berth deck, two on each side. There were two 10-inch breech-loading rifles in the forward and two in the after turret, the turrets and guns being worked by hydraulic gear. Besides these, there were six 6-inch breech-loading rifles, two mounted forward inside the superstructure deck firing directly ahead, two abaft the cabins firing directly astern, and one on each side on the central superstructure deck. The 10-inch and the 6-inch guns could all be fired in broadside, throwing a weight of projectile on each side of about 2,400 pounds at one discharge. The 6-inch guns were worked by hand, on central pivot carriages, and were protected by steel shields, 2 inches thick. The secondary battery consisted of seven 6-pounder Driggs-Schroeder rapid-fire guns; four 1-pounder Hotchkiss; four 1-pounder Driggs-Schroeder, and four machine guns (Gatling). This information was gathered from the journal of the naval engineers' society and is specific and correct.

For Dredging Portage Lake Canals.

Following is an abstract of proposals opened at Duluth on Monday last by Major Clinton B. Sears, corps of engineers, U. S. A., for dredging in Portage Lake ship-canals, Keweenaw point, Lake Superior. The amount proposed to be expended on this work was $80,000. The Racine Dredging Co., Racine, Wis., was the lowest bidder, at $75,900:

Name and address of bidder.	For dredging per cubic yard, scow measurement. Sec. 1. 50,000 cu. yds. cts.	Sec. 2 100,000 cu. yds. cts.	Sec. 3. 800,000 cu. yds. cts.	For use of dredging plant per hour.	Total.
Racine Dredge Co., Racine	10	14.9	7	$9	$75,900
Carkin, Stickney & Cram, Detroit	17	20	9	14	100,500
The Lydon & Drews Co., Chicago	22	24	12	16	151,000
C. E. Mitchell & Co., Ludington	19	19	10	9	108,530
Green's Dredging Co., Chicago	15	25	12	10	128,500
The L. P. & J. A. Smith Co., Cleveland	20	24	12	15	130,000
Arthur H. Vogel, Milwaukee	14	17	10	15	104,000
Adolph F. Bues, Milwaukee	10	12	8	10	81,000
James Pryor, Houghton	11	14	9½	10	95,500
Geo. H. Breymann and John B. Breymann, Toledo. / Green Bay Dredge and Pile Driving Co., Green Bay	14 / 20	15 / 12	9 / 8	15 / 10	94,000 / 86,000
Illinois Dredging Co., Chicago	12	20	9	15	98,000

Steamboat service between Detroit and Cleveland will be begun by the D. & C. Nav. Co. on the 15th inst., if weather permits.

Appointments of Captains and Engineers.

Richardson, W. C., Cleveland: Steamers—Samuel Mitchell, Capt. Thomas Wilford, Engineer James Clancy; J. H. Wade, Capt. Richard Call, Engineer George McMonagle; Wm. Chisholm, Capt. Charles Cleveland, Engineer Silas H. Hunter; J. H. Devereaux, Capt. John H. Babbitt, Engineer James Falconer; Roumania, Capt. Lewis W. Stone, Engineer Martin Burns; J. H. Outhwaite, Capt. Enos J. Burke, Engineer R. A. Davidson; Iroquois, Capt. Thomas Jones, Engineer E. W. Prince. Schooners—John J. Barlum, Capt. John McKeighan; H. A. Barr, Capt. Harry W. Phillips.

Calvin & Co., Garden Island, Ont.: Steamers—D. D. Calvin, Capt. A. Malone, Engineer T. C. Smith; Bothnia, Capt. Geo. Brian, Engineer R. Veech; Armenia, Capt. Chas. Coons, Engineer Geo. Hazlett; Chieftain, Capt. John Sullivan, Engineer Thos. Gray; Parthia, Capt. David Lefavre, Engineer Geo. Sauve; Johnston, Capt. D. Lefavre, Jr., Engineer Ed. Phelix; Bluebell, Capt. John Dix, Engineer Fred. Lefavre; Reginald, Capt. John Doyle, Engineer John Kennedy. Schooners—Ceylon, Capt. H. Smith; Augustus, Capt. Jos. Achee; Valencia, Capt. John Ferguson; Norway, Capt. John Harris.

Cleveland-Cliffs Iron Co., Cleveland: Steamers—Pontiac, Capt. C. Z. Montague, Engineer George Waterbury; Frontenac, Capt. S. N. Murphy, Engineer E. V. Barry; Cadillac, Capt. George A. Symes, Engineer T. J. Reese; Pioneer, Capt. S. A. Lyons, Engineer E. I. Jenkins; Kaliyuga, Capt. A. R. Robinson, Engineer Chas. Stoeber. Schooner—Fontana, Capt. A. C. Reimers.

Detroit, Belle Isle & Windsor Ferry Co., Detroit: Steamers—Pleasure, Capt. Geo. Shanks, Enginer Nicholas Huff; Promise, Capt. John Wilkinson, Engineer Henry Free; Victoria, Capt. John Foster, Engineer Walter Merrill; Excelsior, Capt. Fred. Jarvis, Engineer ———; Garland, Capt. M. McCune, Engineer Fred. Wolfgang; Sappho, Capt. John Cary, Engineer Albert Garland; Fortune, Capt. Geo. D. Howe, Engineer ——.

Brittain, R. C., Saugatuck, Mich.: Steamers—Frank Woods, Capt. Chas. A. Plummer, Engineer ———; O. E. Parks, Capt. O. E. Parks, Engineer F. D. Redner; H. A. Root, Capt. Samuel Olson, Engineer Fred. Menier; J. C. Luit, Capt. John Rode, Engineer Samuel Johns; Chas. McVea, Capt. C. B. Coates, Engineer Henry Bender; Mae Martel, Capt. N. G. Edgecomb, Engineer Wm. Rode. New passenger steamer—Capt. John Snay, Engineer ———.

Leathem & Smith Towing & Wrecking Co., Sturgeon Bay, Wis.: Steamers—Joseph L. Hurd, Capt. John Walker, Engineer Geo. Keister; Pewaukee, Capt. Sam. Christopher, Engineer Frank Larsen; I. N. Foster, Capt. Charles Packard, Engineer James Curry. Tugs—John Leathem, Capt. Henry Tufts, Engineer Oley Sanders; Syd. Smith, Capt. P. Batcheller, Engineer John McMillan; Geo. Nelson, Capt. James Tufts, Engineer Ashley Cofferine; A. J. Wright, Capt. Thomas Isabell, Engineer ———. Barges—Emerald, Capt. Olsen; Evaline, Capt. G. Anderson; L. B. Shepard, Capt. ———.

Eddy Bros., Bay City, Mich.: Steamers—City of Bangor, Capt. Wm. Cavers, Engineer Henry Annett; Penobscot, Capt. J. H. Coleman, Engineer S. G. Cowell; Selwyn Eddy, Capt. T. D. Gibson, Engineer Geo. B. Wilson; E. C. Pope, Capt. John Burns, Engineer John M. Conroy.

Corning & Edgar, Saginaw, E. S., Mich.. Steamers—C. H. Green, Capt. C. E. Little, Engineer Charles Lamb; Oseoda, Capt. G. W. Ryan, Engineer Jacob Oscar. Schooners—Our Son, Capt. Peter Edgar; Genoa, Capt. D. C. Ryan; Ida Corning, Capt. Peter H. Edgar; C. G. King, Capt. Michael Ryan.

Flint & Pere Marquette R. R. Line, Ludington, Mich.: Steamers—F. & P. M. No. 2, Capt. R. Haslebarth, Engineer Geo. Depuy; F. & P. M. No. 3, Capt. Chas. Thompson, Engineer H. Nyland; F. & P. M. No. 4, Capt. Jos. Russell, Engineer F. McLaren; F. & P. M. No. 5, Capt. J. J. Doyle, Engineer W. H. Stone; Pere Marquette, Capt. F. A. Dority, Engineer Robt. McLaren.

North Shore Nav. Co., Collingwood, Ont.: Steamers—City of Collingwood, Capt. W. J. Bassett, Engineer Chas. Robertson; City of Midland, Capt. F. X. LaFrance, Engineer Wm. Whipps; City of Parry Sound, Capt. Ernest Walton, Engineer J. L. Smith; City of Toronto, Capt. A. C. Cameron, Engineer David McQuade; City of London, Capt. Geo. Dunn, Engineer C. Wilber.

Mutual Transportation Co., Geo. P. McKay, Mngr., Cleveland: Steamers—Coralia, Capt. Wm. Cumming, Engineer Chas. G. Love; Corsica, Capt. Jas. A. Walsh, Engineer Andrew J. Haig; Corona, Capt. Stephen Murphy, Engineer Grant Donaldson; Cambria, Capt. Martin Johnson, Engineer Fred. Warring.

Menominee Transit Co., Geo. P. McKay, Mngr., Cleveland: Steamers—Saxon, Capt. Wm. C. Goodsell, Engineer Geo. E. Averill; Briton, Capt. Jas. B. Watts, Engineer Wm. R. Donaldson; German, Capt. Wm. Baxter, Engineer Thos. Kelley; Grecian, Capt. A. C. Chapman, Engineer O. H. Gillmore; Roman, Capt. A. J. Greenley, Engineer S. A. Wells.

Smith, Edward, Buffalo: Steamers—Thos. Cranage, Capt. John S. McNeil, Engineer E. W. Lafraine; City of Venice, Capt. Chas. Ainsworth, Enginer A. McLachlan; City of Paris, Capt. E. D. Ballentine, Engineer G. McLachlan; Samoa, Capt. John Isbister, Engineer L. Walpole; Samuel Marshall, Capt. August Jean, Engineer B. Leitch. Schooner—Samuel J. Tilden, Capt. John Burke.

Niagara Navigation Co., John Foy, Manager, Toronto, Ont.: Steamers—Chippewa, Capt. J. McGiffin, Engineer R. McCaul; Corona, Capt. W. H. Solmes, Engineer I. Walsh; Chicora, Capt. R. Clapp, Engineer H. Parker; Ongiara, Capt. R. McIntyre, Engineer ———.

Inter-Ocean Transportation Co., David Vance & Co., Mgrs., Milwaukee: Steamers—Maryland, Capt. J. E. Yax, Engineer M. Conley; Manchester, Capt. T. Kelly, Engineer J. Grant; Manhattan, Capt. H. F. Loftus, Engineer W. R. Patterson; Massachusetts, Capt. P. A. Anderson, Engineer, W. Ahern; Merrimac, Capt. M. Smith, Engineer L. Allison; Minnesota, Capt. B. Sniffin, Engineer W. H. Pinkham. Schooner—Metacomet, Capt. W. L. Shields.

McBrier, James, Erie, Pa.: Steamers—Fedora, Capt. F. A. Fick, Engineer John Stephens; Nyanza, Capt. W. W. Wilkins, Engineer M. McAuliff; Uganda, Capt. C. H. Wilson, Engineer ———; Sevona, Capt. D. S. McDonald, Engineer Wm. Phillipe.

Gray, R. T., Detroit: Steamers—John Owen, Capt. E. F. Thorp, Engineer S. L. Phillips; J. Emory Owen, Capt. F. C. Hart, Engineer ———. Schooner—Michigan, Capt. F. J. Cadotte.

Fletcher, F. W., Alpena, Mich: Steamers—F. W. Fletcher, Capt. J. A. Stewart, Engineer ———. Tugs—John Owen, Capt. Thos. Lillis, Engineer ———; Frank W., Capt. John Lawson, Engineer ———. Schooner—India, Capt. L. Hanson.

Marine Transit Co., Marine City, Mich.: Steamers—Toltec, Capt. Jas. Taylor, Engineer Amos Horton; Aztec, Capt. J. W. Baby, Engineer A. Beauchamp. Schooners—Zapotec, Capt. P. Thomson; Miztec, Capt. R. Smith.

Rhodes, R. R., Cleveland: Steamers—Yale, Capt. John Coulter, Engineer Harry Stone; Neshoto, Capt. P. Dowdell, Engineer Henry Stone; R. R. Rhodes, Capt. W. Moore, Engineer Chas. Beebe.

Playfair Barge & Tug Line, Midland, Ont.: Steamer—St. Andrew, Capt. W. H. Featherstronghaugh, Engineer John McRae. Tugs—Magnolia, Capt. R. H. Gilbertson, Engineer E. A. House; Metamora, Capt. Jas. Tyndall, Engineer Geo. Smith; Minitaga, Capt. Ed. Burke, Engineer John Sinnott.

Hope Transportation Co., John A. Francombe, Manager, Detroit: Steamer—W. R. Stafford, Capt. A. P. Gallinow, Engineer John A. Francombe. Schooners—Ed. McWilliams, Capt. Geo. Johnson; J. A. Francombe, Capt. Geo. McKenna.

Morley & Hill, Marine City, Mich.: Steamers—W. B. Morley, Capt. J. A. Nicolson, Engineer P. Caniff; St. Lawrence, Capt. A. H. Senghas, Engineer Tib. Durant; J. J. Hill, Capt. John Andrews, Engineer John Sirtch.

Thompson, John, St. Clair, Mich.: Steamers—Douglas, Capt. F. J. Meno, Engineer Jos. Meno; Pilgrim, Capt. Eugene Hayward, Engineer Porter Robinson.

Mather, W. G., Cleveland: Steamers—Presque Isle, Capt. James B. Lowe, Engineer Thomas B. Kelley; E. S. Pease, Capt. Thos. Sloan, Engineer ———. Schooner—Planet, Capt. Frank Parsson.

Wisconsin Steamship Co., Milwaukee: Steamer—F. Schlesinger, Capt. D. P. Craine; Engineer A. R. Fortier; G. H. Dyer, Capt. A. E. McGregor, Engineer G. E. Robinson.

Milwaukee S. S. Co., David Vance & Co., Milwaukee, Wis.: Steamers—R. P. Flower, Capt. F. W. Vaupatten, Engineer D. Darcey; F. L. Vance, Capt. E. B. Marquette, Engineer J. E. Mason.

Sylvester Bros., Toronto, Ont.: Steamer—Eurydice, Capt. J. Jackson, Engineer Alex. Munro. Schooner—St. Louis, Capt. Geo. Williamson.

Beyschlag, Chas., St. Clair, Mich.: Steamer—P. J. Ralph, Capt. Henry Leisk, Engineer W. J. Bolton. Schooner—Harold, Capt. Thos. Leisk.

Rice, W. E., Port Huron, Mich.. Propeller—Rhoda Stewart, Capt. W. E. Rice, Engineer Jas. A. Southgate. Barge—Magnet, Capt. Elmer Campbell.

Ashley & Dustin, Detroit: Steamers—Frank E. Kirby, Capt. A. J. Fox, Engineer E. Perry; Wyandotte, Capt. Jos. Waltman, Engineer J. Holder.

Merchants' Line, G. E. Jacques & Co., Montreal: Propellers—Cuba, Capt. Robert Chestnut, Engineer Wm. Kennedy; Melbourne, Capt. Hy. Chestnut, Engineer Thos. Milne.

Erie Dock & Transportation Co., Erie, Pa.: Steamer—Massasauga, Capt. B. P. Bates, Engineer Frank Blake.

Loutit, W. H., Grand Haven, Mich.: Steamer—Pentland, Capt. Thos. McCambridge, Engineer C. Ball.

Brown, H. H., Cleveland: Steamer—Castalia, Capt. C. C. Allen, Engineer Edward Dempsey.

Langell, S., St. Clair, Mich.: Steamer—Oscar F. Flint, Capt. R. O'Conor, Engineer P. J. Merril.

American Transportation Co., Fairport, O.: Steamers—Alex. Nimick, Capt. D. P. Wright, Engineer E. J. Burns; Jno. Harper, Capt. F. A. Graves, Engineer Edward Riley. Schooners—Antrim, Capt. W. N. Borthwick; Tyrone, Capt. F. E. Johnson.

Bigelow, A. A., Chicago: Steamer—Madagascar, Capt. John Jenks, Engineer Chas. Nerreter. Schooners—S. M. Stephenson, Capt. John Cowan; Fanny Neil, Capt. C. K. Moore.

Rietz, Chas. F., Chicago: Steamer—Chas. Rietz, Capt. D. A. Curran, Engineer W. J. Merrill. Schooners—Agnes L. Potter, Capt. Christian Edwardson; John Mark, Capt. Joseph Reddin.

Sands, Louis, Manistee, Mich.: Steamer—Maggie Marshall, Capt. August E. Anderson, Engineer ———. Schooners—Isabella Sands, Capt. August Johnson; A. W. Luckey, Capt. J. L. Jensen; Arendal, Capt. ——.

Lester, Thomas, Marine City, Mich.: Steamer—Tempest No. 1, Capt. George H. Lester, Engineer Joseph Schnell. Schooners—Emma L. Coyne, Capt. Henry G. Lester; Uranus, Capt. J. M. Balfour.

Mackinac Transportation Co., St. Ignace, Mich.: Steamers—Sante Marie, Capt. L. R. Boyton, Engineer R. Walsh; Saint Ignace, Capt. ———, Engineer M. H. O'Brien; Algomah, Capt. G. W. Boynton, Engineer Joseph Rosseau.

Nester, Geo., Detroit: Steamer—Schoolcraft, Capt. Wm. Tomlin, Engineer John Murran. Schooners—Mary N. Bourke, Capt. R. Tomlin; Geo. Nester, Capt. J. H. Baisclair.

Egan, W. M., Chicago: Steamer—City of Rome, Capt. LeRoy A. Rand, Engineer Alfred E. Welch.

Griffin, J. B., Saugatuck, Mich.: Steamer—Saugatuck, Capt. John Campbell, Engineer Wm. Bradley.

Hopkins Steamship Co., St. Clair, Mich.: Steamer—Centurian, Capt. David Hutchinson, Engineer Thomas Walsh.

Hebard & Son, Charles, Pequaming, Mich.: Steamer—Charles Hebard, Capt. James Parsons, Engineer Wm. Shoemaker. Tug—D. L. Hebard, Capt. Hugh McKenzie, Engineer Jos. Grauliof. Schooners—Aloha, Capt. Wm. Elliott; Annabel Wilson, Capt. Dan'l Nathan; Annie M. Peterson, Capt. Baugh.

Candler, J. W., Detroit: Steamer—M. M. Drake, Capt. Peter C. Bassett, Engineer C. Mugkelburg. Schooner—Senator, Capt. Chas. Anderson.

Sinclair, Alex. R., Duluth: Steamer—Simon Langell, Capt. Chas. W. Black, Engineer Robt. Cameron. Schooner—Arenac, Capt. Wm. F. Hormig.

Fitzgerald, W. E., Milwaukee: Steamer—Geo. C. Markham, Capt. J. D. Wanvig, Engineer L. Brown.

Blodgett, Wm. C., Buffalo: Steamer—St. Joseph, Capt. Geo. E. Talbot, Engineer J. A. Braman.

MARINE REVIEW

DEVOTED TO LAKE MARINE AND KINDRED INTERESTS.

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The books of the United States treasury department on June 30, 1896, contained the names of 3,333 vessels, of 1,324,067.58 gross tons register in the lake trade. The number of steam vessels of 1,000 gross tons, and over that amount, on the lakes on June 30, 1896, was 383 and their aggregate gross tonnage 711,034.28; the number of vessels of this class owned in all other parts of the country on the same date was 315 and their tonnage 685,204.55, so that more than half of the best steamships in all the United States are owned on the lakes. The classification of the entire lake fleet on June 30, 1896, was as follows:

	Number.	Gross Tonnage.
Steam vessels	1,792	924,630.51
Sailing vessels and barges	1,125	354,327.60
Canal boats	416	45,109.47
Total	3,333	1,324,067.58

The gross registered tonnage of the vessels built on the lakes during the past six years, according to the reports of the United States commissioner of navigation, is as follows:

Year ending June 30. 1891	204	111,856 45
" " " 1892	169	45,968.98
" " " 1893	175	99,271.24
" " " 1894	106	41,984.61
" " " 1895	93	36,352.70
" " " 1896	117	108,782.38
Total	864	444,216.36

ST. MARY'S FALLS AND SUEZ CANAL TRAFFIC. (*From Official Reports of Canal Officers.*)

	St.Mary's Falls Canals.			Suez Canal.		
	1896*	1895*	1894	1896	1895	1894
Number of vessel passages	18,615	17,956	14,491	3,409	3,434	3,352
Tonnage, net registered	17,249,418	16,806,781	13,110,366	8,560,284	8,448,383	8,039,175
Days of navigation	232	231	234	365	365	365

*1895 and 1896 figures include traffic of Canadian canal at Sault Ste. Marie.

Mr. Charles H. Cramp is quoted as saying: "Torpedo boats are not only not sea-going craft, but they are not even part of the navy proper. They add nothing whatever to the actual naval strength of the nation. They are simply adjuncts of harbor defense; floating guns, you might say, adapted for a peculiar form of projectile. A navy is necessarily a sea-going and sea-keeping institution. Torpedo boats are essentially a port-staying and harbor-defending institution. There is no more analogy between a navy proper and torpedo boats than between a navy and submarine mines or disappearing coast batteries. I have seen it stated in discussion that 100 80-foot torpedo boats could be built for the cost of one battleship. This misleads the public. You might as well say that 100 submarine mines could be planted for one torpedo boat. No one is more sensible than I of the value of torpedo boats within their peculiar and limited sphere. But they add nothing to the general naval power and prestige of the country. We might have one for every mile of our coast and yet if we did not have a real navy of sea-going ships, armored and unarmored, we would be as helpless a league from shore as Hayti is."

Assistant Naval Constructor Robert B. Dashiell, U. S. N., who went abroad to examine into the construction of government dry docks, has returned after an interesting visit. He found in England that all docks, with few unimportant exceptions, were of stone or concrete, and that wooden docks had long passed out of use. Docks in which vessels had been put in the French revolution were now accommodating 30-knot torpedo boat destroyers and other small craft. Mr. Dashiell found that many of England's present stone docks were constructed in the last century, and are still in use and almost as good as new. It is reported that his opinion is that no further timber docks be built for the navy and that the highest type of concrete docks be authorized. The English docks, he reports, are the finest in the world, and there are probably more of them than the combined available supply of France, Germany and Russia. —Army and Navy Journal.

Among the largest steam yachts owned in this country are the Valiant, William K. Vanderbilt, 332 feet long, 39.2 feet beam, and 16.6 draft; Niagara, Howard Gould, 272 feet long, 36 feet beam, 16 feet draft; Nourmahal, John Jacob Astor, 250 feet long, 30 feet beam, 14.3 feet draft; Corsair, J. Pierpont Morgan, 241.6 feet long, 27.2 feet beam, 13 feet draft; Eleanor, W. A. Slater, 232 feet long, 32 feet beam, 14 feet draft; May, E. D. Morgan, 226 feet long, 27.8 feet beam, 14.5 feet draft; Josephine, P. A. B. and G. G. Widener, Philadelphia, 225 feet long, 28 feet beam, and 11.6 feet draft; Comanche, H. M. Hanna, Cleveland, 172 feet long, 25 feet wide; Wadena, J. H. Wade, Cleveland, 158 feet long, 20 feet wide; Enquirer, W. J. Conners, Buffalo, 133 feet long, 17 feet wide.

Duluth's newspaper correspondents certainly take the prize for "fake stories." They have been writing of late about a second ship-canal through Minnesota point, to be dug opposite the swing of the Duluth-Superior bridge, so as to enable vessels loaded in the upper bay to steer a straight course for the lake after passing through the bridge, and thus avoid the time required to navigate around the corner of Connor's point and through Duluth harbor to the government canal. And this is to be a private undertaking! A case of competition with the government. Tolls are to reimburse the stockholders of the proposed company.

Fred. A. Ballin, formerly with the Detroit Boat Works and now superintendent of the Wolf & Zwicker Iron Works of Portland, Ore., is advertising for fifty ship carpenters. "There will be plenty of work on the Pacific coast for the next two years," he says, "and as ships will be building all along the coast men will find steady employment. As there is little doing in wooden ship building on the lakes, it would seem that this is a favorable opportunity for idle men who are willing to work.

It is certainly a compliment to Geo. Clinton of Buffalo that he should be selected as arbitrator in the collision case of the Susquehanna and Ira H. Owen. Mr. Clinton's ability as an admiralty lawyer has been fully recognized of late, and the trial of this case out of court may cause other vessel owners to favor arbitration as against the delays and expense of court proceedings.

Reports submitted to the American Iron & Steel Association show the total production of Bessemer steel ingots for 1897 to have been 5,475,315 gross tons, an increase over 1896 of 1,555,400 tons. The production for 1897 was the largest in the history of the country. There was increase in the production of Bessemer steel rails, the same periods compared, of 511,507 tons.

Two or three grain carriers have been unloaded at Buffalo and in each case the elevators refused to accept pay for the use of steam shovels, pending a settlement of elevator affairs for next season. It would not be surprising to find all the Buffalo elevators engaged in a scramble for business next season, as their differences have multiplied of late.

The London Shipping Gazette announces that James Gordon Bennett has commissioned G. L. Watson to design for him a palatial steam yacht to be built on the Clyde, to be 310 feet long, have quadruple expansion engines of 7,000 horse power, and a sustained sea speed of 15 knots.

The 700-foot White Star liner Oceanic was launched at the ship yard of Harland & Wolff, Belfast, Ireland, on Saturday last.

Wonderful Progress in the Iron Industry.

At the present time there are mills that can roll more steel rails in a month than any one mill in this country could produce in a year a quarter of a century ago, and that, too, with the aid of much less help. Less than one-third the number of workmen are now required for a given output of rails than were needed twenty years ago. These facts are brought out by an interview in the New York Commercial Advertiser with a veteran iron and steel manufacturer regarding changes that have taken place in the industry during the last three decades. Steel rails were first turned out in this country in 1867 and brought $160 a ton. Hardly six years had elapsed when the cost was scaled down to $90 a ton, and one mill produced 30,000 tons a year. The producing capacity was further augmented until 50,000 tons had been reached in one year, which figure at the time was considered marvelous. In 1871 the duty on steel rails amounted to $28 a ton and the average price per ton was $102.50. When it is stated that steel rails sold for export last year at $16 per ton, the extent of the transition is at once obvious. A number of factors have combined to bring about these changes. Chief among them may be mentioned the cheapened rates of transportation, low-priced ore and improved methods of production in the form of mechanical devices which have replaced hand labor. The extent to which steel rails have been substituted for iron rails may be gathered from the fact that in 1867 only 2,277 tons of steel rails and 410,319 tons of iron rails were turned out from the mills. On the other hand, the year 1896 brought forth 1,117,663 tons of steel rails as against 4,357 tons of iron rails. Inasmuch as steel rails have been found to be more durable and considerably cheaper than the iron rails, the manufacture of the latter has about ceased. While pig iron has decreased greatly in value, the cost of steel has been lessened much more in proportion, because of the discovery and the superior utilization of improvements in the Bessemer process.

F. W. Wheeler and Co.'s Output in 1896.

The statement that there was probably not a ship yard on the lakes that had built vessels aggregating more than 20,000 gross tons in a single year, has brought out reports from the different ship building companies, and it is found that the Globe Iron Works Co., Chicago Ship Building Co. and F. W. Wheeler & Co. have all exceeded that amount of tonnage in a single year's output. The latest report is from F. W. Wheeler & Co. of West Bay City, showing an output of 31,357 gross tons in 1896, as follows:

	Gross tonnage.	Net tonnage.	Horse power.
L. C. Waldo	4,244	3,290	2,000
City of Bangor	3,690	2,986	1,800
E. W. Oglebay	3,666	3,019	2,000
Lagonda	3,647	3,017	2,000
George Stephenson	4,583	3,502	2,500
James Nasmyth*	3,418	3,158	
Sir Isaac Lothian Bell*	3,418	3,158	
Pere Marquette	4,691	4,134	2,000
	31,357	26,264	12,300

*Steel tow barges; all others steel steamers.

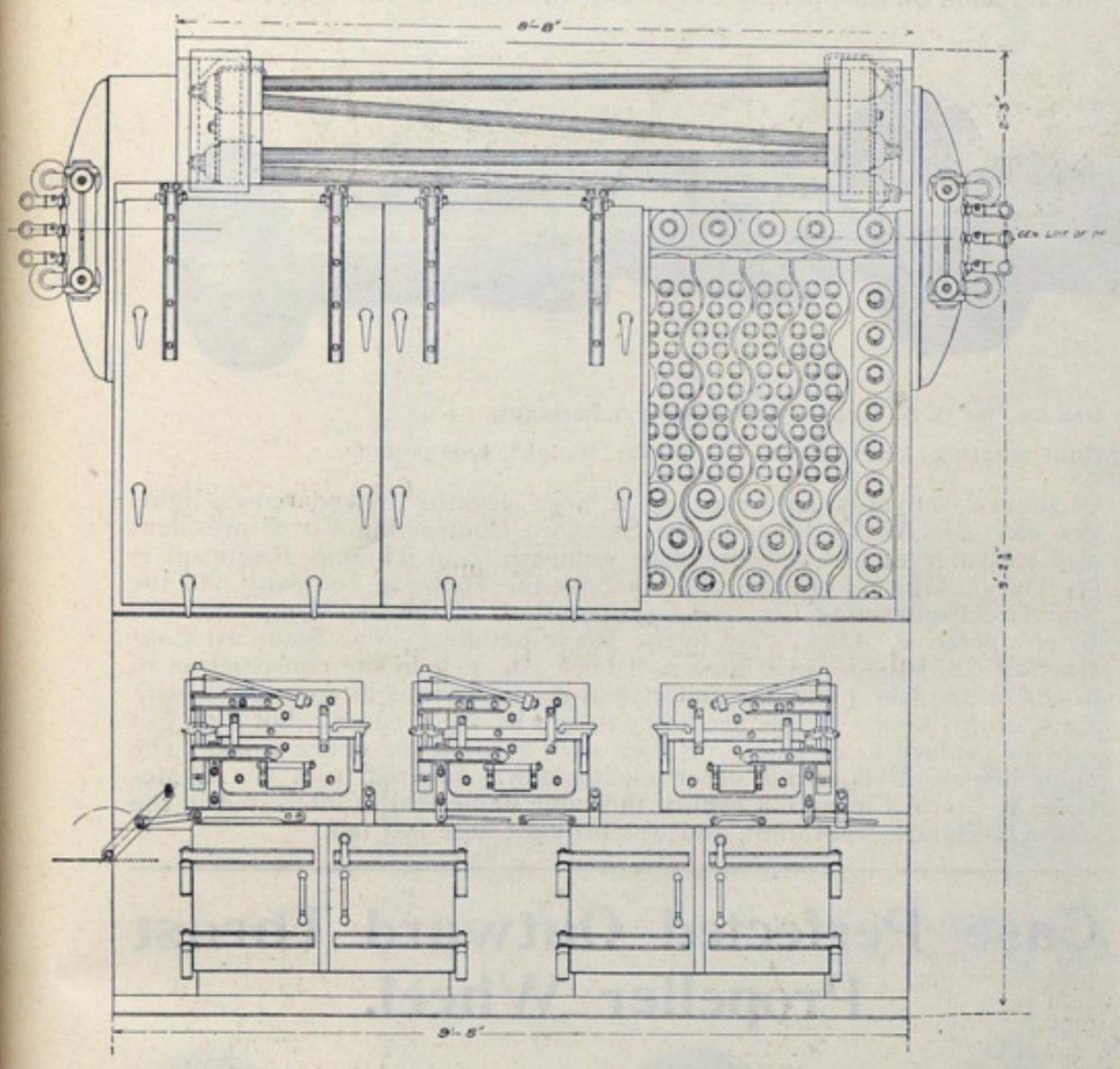
The Iowa Iron Works, Dubuque, Iowa, has secured two more important contracts for vessels. One is a large steel tugboat for the government, to be used on the lower Mississippi, to be furnished with machinery and all other appliances by the contractors. The other is a large dredge.

A steam vessel 75 feet long for survey service on the Yukon will be built for the government by the Gas Engine & Power Co. and Seabury & Co., Consolidated, of Morris Heights, New York. The vessel will be "knocked down" and loaded on cars at Morris Heights and then shipped to Seattle, where she will be set up again ready for service in June.

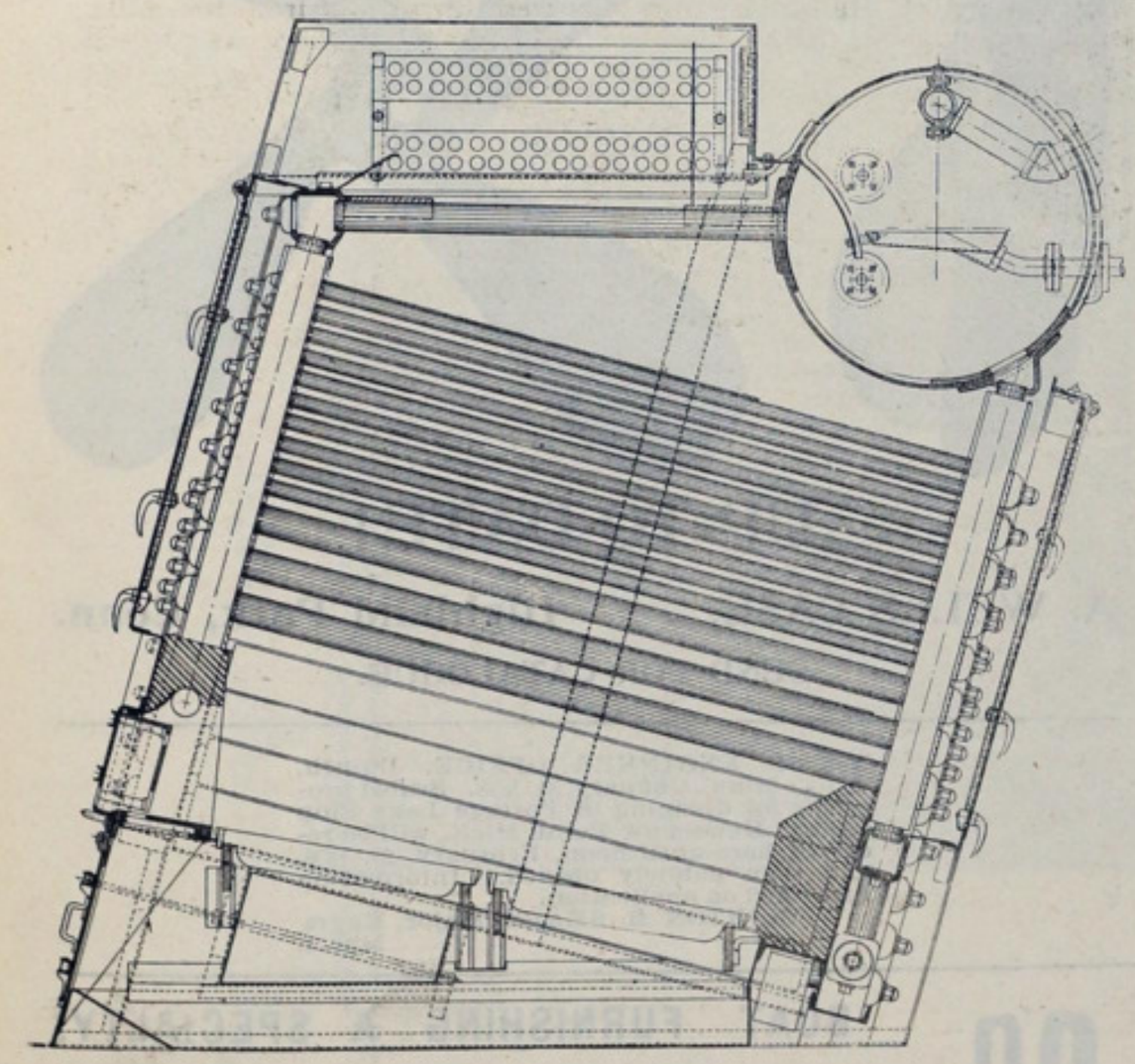
COAL TESTS ON THE MARIETTA.

ONE OF THE UNITED STATES GUNBOATS MAKES 204 MILES A DAY ON SIX AND A HALF TONS OF COAL.

On her recent trip from San Francisco to Acapulco, Mexico, the United States gunboat Marietta showed what the new type of naval vessel may do in the matter of economy of coal. She left San Franscico Jan. 16 and arrived at Acapulco Jan. 25, after a trip marked only by good weather and smooth seas. During the trip, runs were made for periods of forty-eight hours each, the engine revolutions being maintained at as near a constant rate as possible, and a careful account kept of the distance



run and the amount of coal burned during these times. Three different rates of revolutions of engines were taken, giving speeds of 10½, 9½ and 8½ knots respectively. At the 8½-knot speed the wonderfully small coal consumption of 6½ tons a day was obtained. In other words. the Marietta went 264 miles a day on only 6½ tons of coal, or could go more than 7,500 miles on her total coal supply. When one remembers that this



coal expenditure represents not only the steaming, but the electric lighting, ventilating, cooking and heating of the ship, it can be seen how economical this is for a vessel of 1,000 tons displacement.

The following interesting data of the performance of this vessel are from an official report at the navy department from Passed Assistant Engineer W. H. Chambers, U. S. N., the chief engineer:

	1	2	3	4
Boilers in use	A&B	A&B	B	B
Duration in hours	47.97	63.75	47.63	35.35
Distance, patent log, knots	507.7	609.6	543.7	364.8
Mean speed, patent log, knots	10.58	9.56	9.53	8.57
Mean revolutions, main engine	181.1	160.5	160.0	140.3
I. H. P. main and auxiliary machinery	549.5	371.2	360.0	273.8
I. H. P. auxiliary machinery (estimate)	18.0	16.0	17.0	17.0
I. H. P., main engines only	531.5	355.2	343.0	256.8
Coal for all purposes for run, tons	26.60	27.36	17.90	9.46
Coal for auxiliary machinery, including evaporator, blowers and heating ship (estimate)	3.60	5.55	4.00	3.30
Coal for main engine for run	23.00	21.81	13.90	6.16
Coal for main engines per day	11.50	8.20	7.00	4.15
Coal for main engines per I. H. P.	2.02	2.16	1.91	1.52

Auxiliaries in use—Two main circulating pumps; one boiler feed pump; one dynamo; one F. & B. pump; steering engine; all constantly.

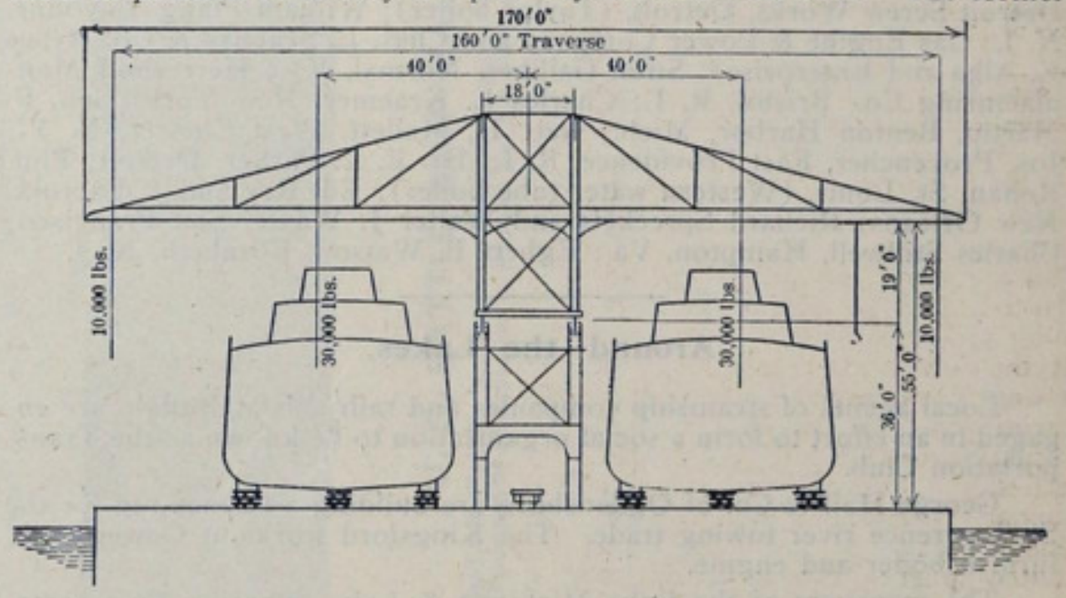
1—Heating ship.
2—Heating ship about half the time; evaporator 0.6 time.
3—Two ventilating blowers 0.5 time; evaporator 0.5 time.
4—Two ventilating blowers 0.5 time; evaporator 0.5 time.

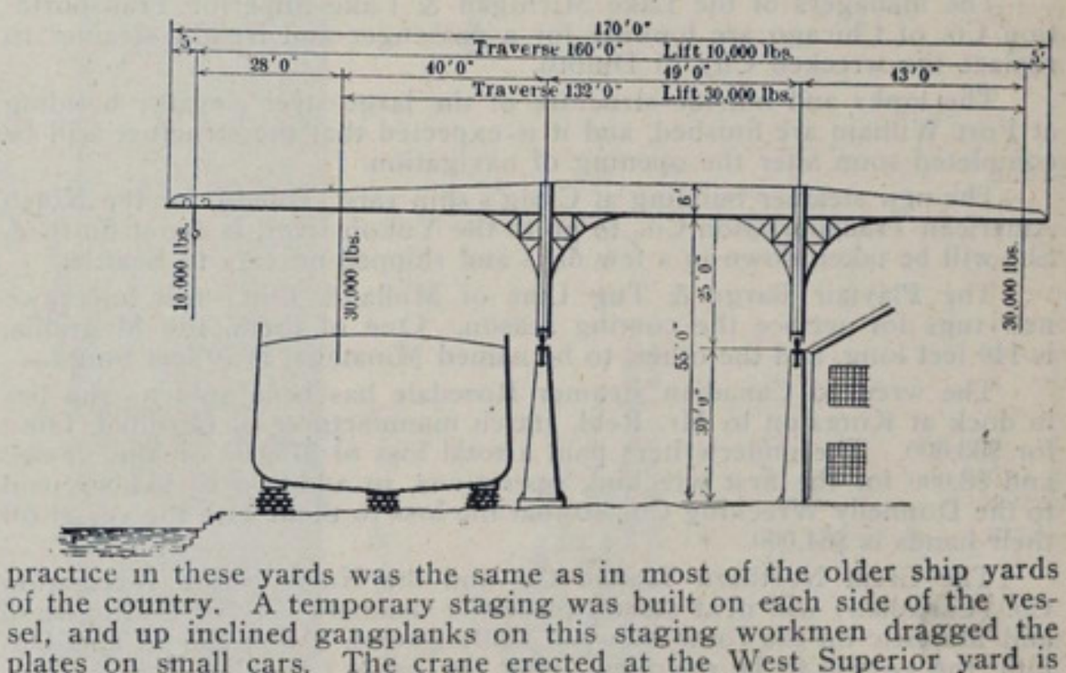
This gunboat is supplied with the Babcock & Wilcox type of water tube boilers, carrying a working pressure of 225 pounds of steam. We illustrate these boilers by two views, showing their front and side elevations. The boilers are composed entirely of straight tubes expanded into wrot steel headers or serpentine manifolds, no cast iron or bent tubes or screwed joints entering into their construction. By the removal of a handhole plate situated opposite the end of each tube the tube interior may be thoroughly examined, cleaned or tube renewed.

Cranes in Lake Ship Yards.

Mr. John W. Seaver of the Wellman-Seaver Engineering Co., Cleveland, spoke of cranes in ship yards at a recent meeting of the local engineers. The drawings presented herewith represent cranes designed for the American Steel Barge Co. of West Superior (upper drawing) and the Union Dry Dock Co. of Buffalo (lower drawing). Cranes in some of the lake yards are said to represent a saving of 30 per cent. in unskilled labor.

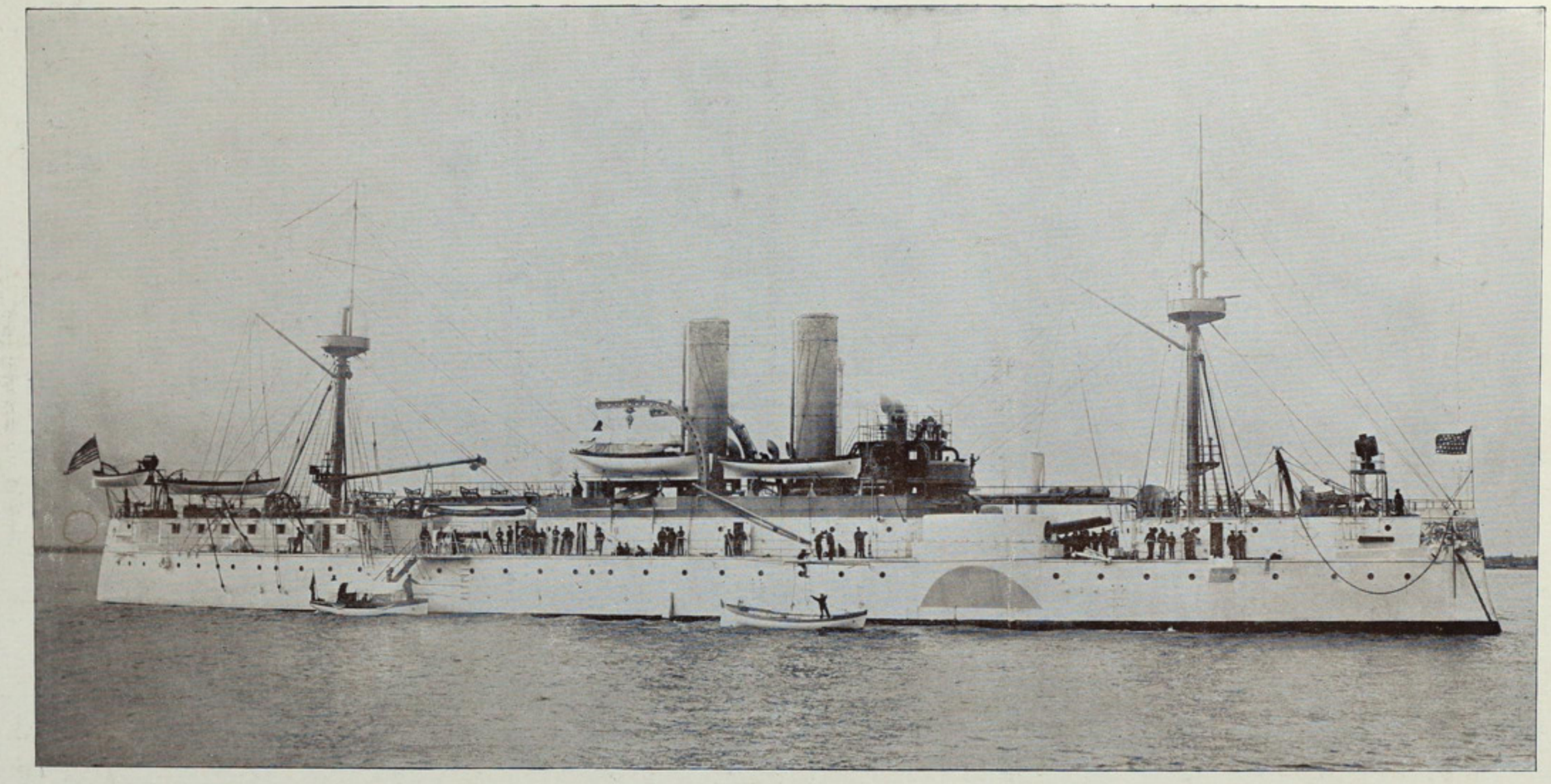
"These two cranes are of different designs," said Mr. Seaver, "yet each, I believe, will represent a large saving in the construction of a ship. The saving will be effected in the reduction of the labor required to transport the plates from the shop and yard to the side of the ship and hold them in position until they are properly secured with bolts. The former





practice in these yards was the same as in most of the older ship yards of the country. A temporary staging was built on each side of the vessel, and up inclined gangplanks on this staging workmen dragged the plates on small cars. The crane erected at the West Superior yard is of the cantilever type and covers berths for two ships. The elevated steel track upon which the crane rests is utilized as a permanent scaffolding for one side of each ship. The material is brought from the punching shop on the small truck seen underneath this scaffolding and lifted up through the scaffolding and run out on one of the arms on either side of the crane to its position over the ship. It is then lowered and held while being secured. This crane is a high-speed crane, having a velocity of 300 feet per minute on the runway, which is some 420 feet long.

"A different service required at the works of the Union Dry Dock Co., Buffalo, necessitated a different design of crane. Only one berth is covered, but the entire yard is served, and one arm extends over the punching shop, which may at any future time be removed, thereby giving an increased yard area covered. The advantage of the second form of construction over the first is that less space is occupied in the yard by the runway, which, in this case, consists of two entirely independent lines of track. This also is a high-speed crane. Both of the cranes are designed for continued and hard service, and are worked by electric motors of ample power to run them to their full capacity."



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Supplement to Marine Review, Cleveland, O., March 3, 1898. Vol. 17, No. 9.

U. S. BATTLE-SHIP MAINE.

Keel laid Oct. 17, 1888; launched Nov. 18, 1890; commissioned Sept. 17, 1895.
Destroyed by an explosion in Havana Harbor, February 15, 1898.

DIMENSIONS:

318 feet load water line.
57 " extreme breadth.
21½ " mean draft.
6,682 tons displacement.
$2,500,000 cost of hull and machinery.
Hull built at Brooklyn Navy Yard.

POWER:

Twin-screw, triple expansion engines,
Cylinders, 35½, 57, 88 by 36 in. stroke.
Boilers, eight single ended 10 by 14 ft. 8 in.
Total horse-power, 9,293; speed, 17.45 knots.
Engines built by Quintard Iron Works.

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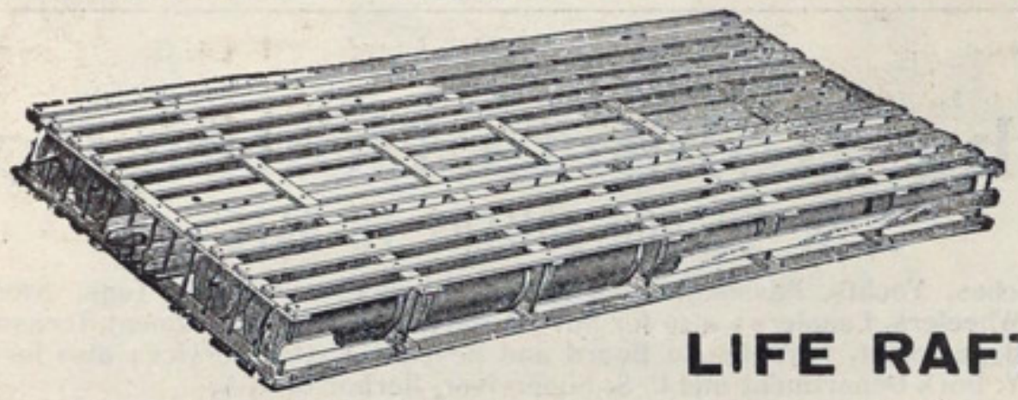

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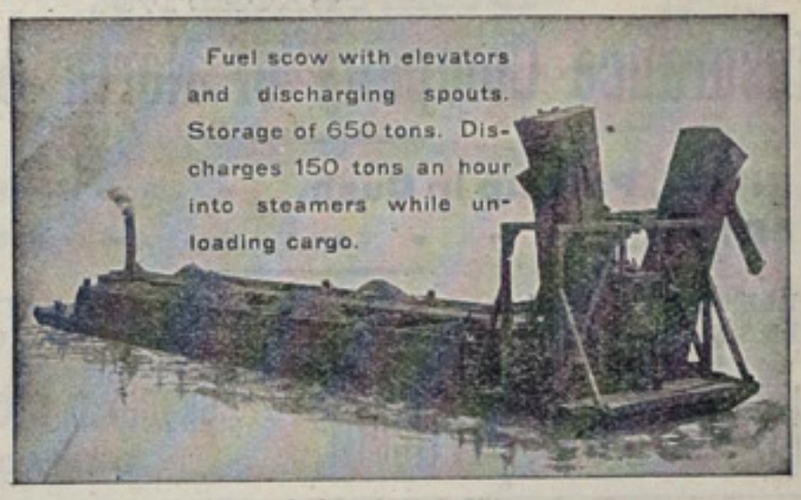
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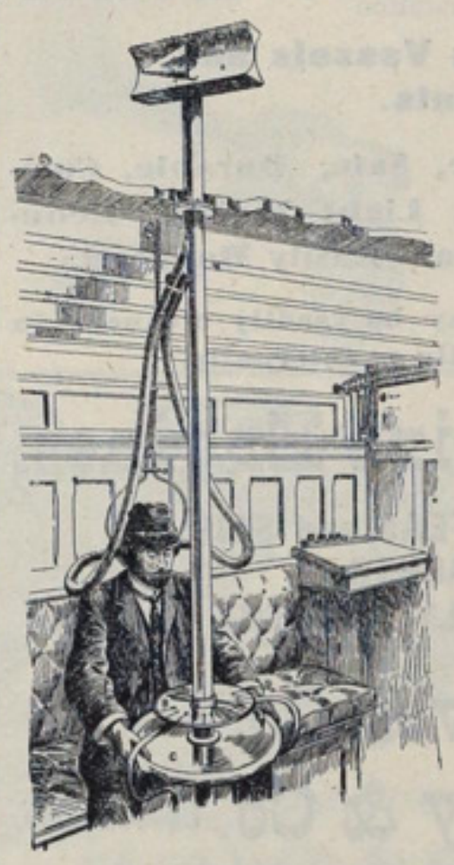

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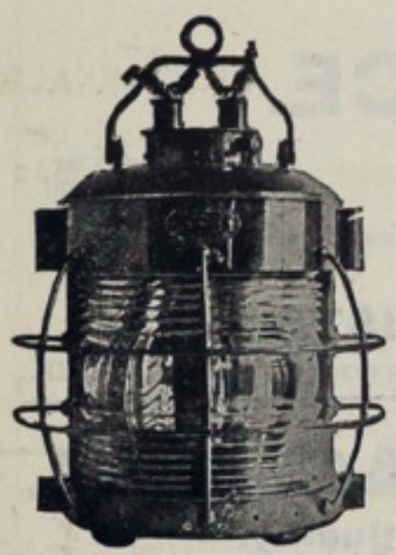

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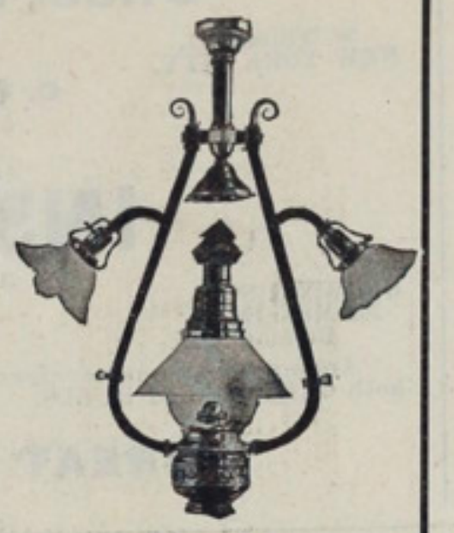

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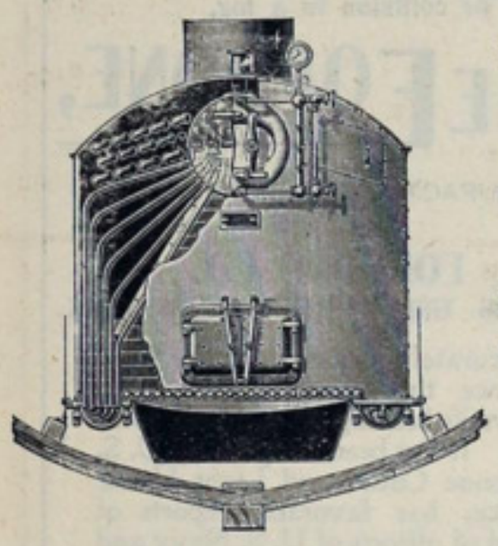

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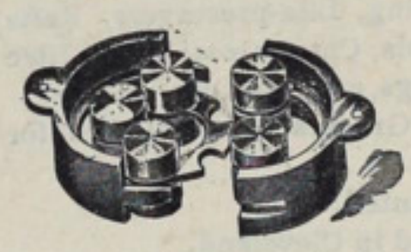

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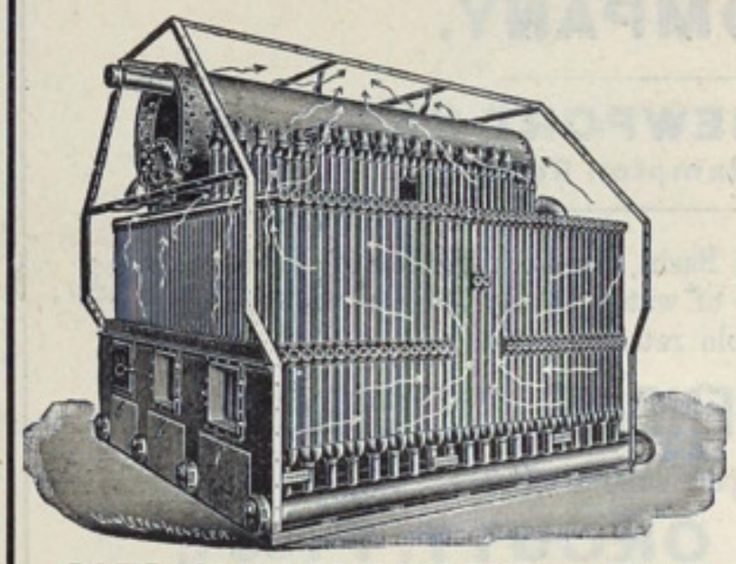

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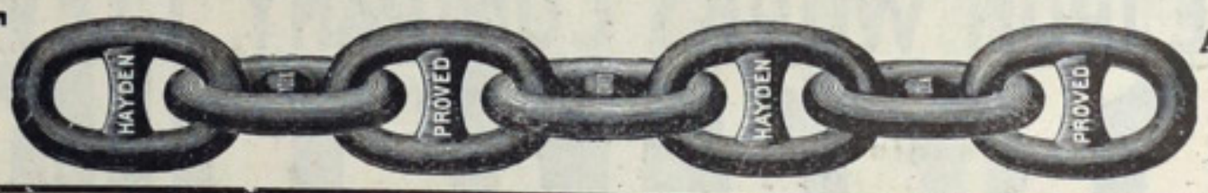

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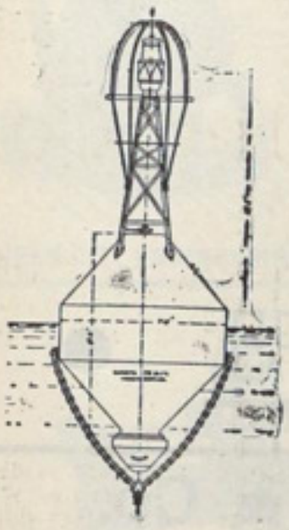

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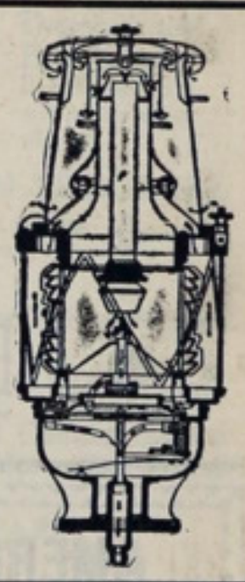

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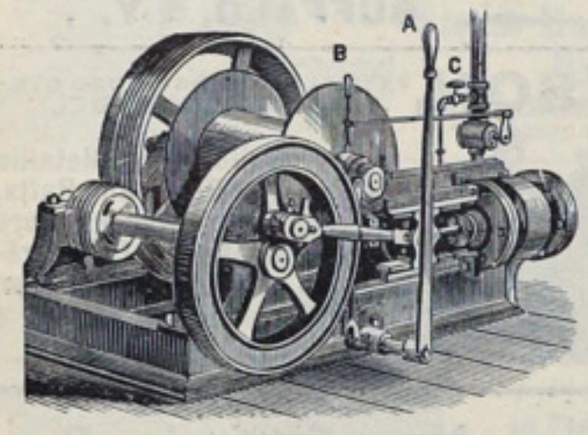

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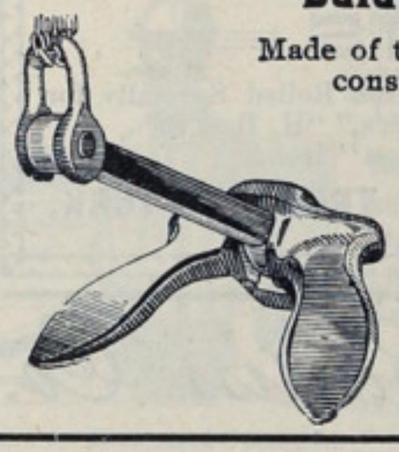

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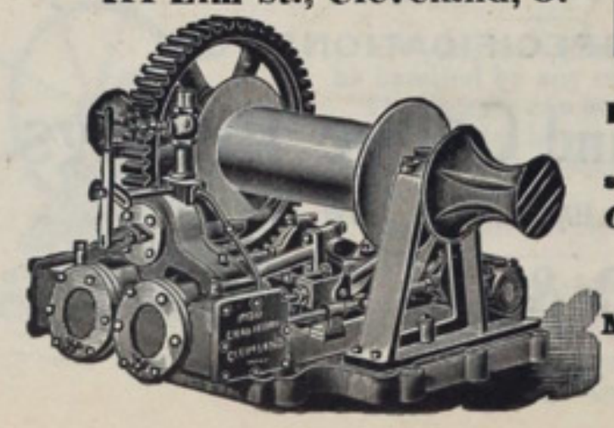

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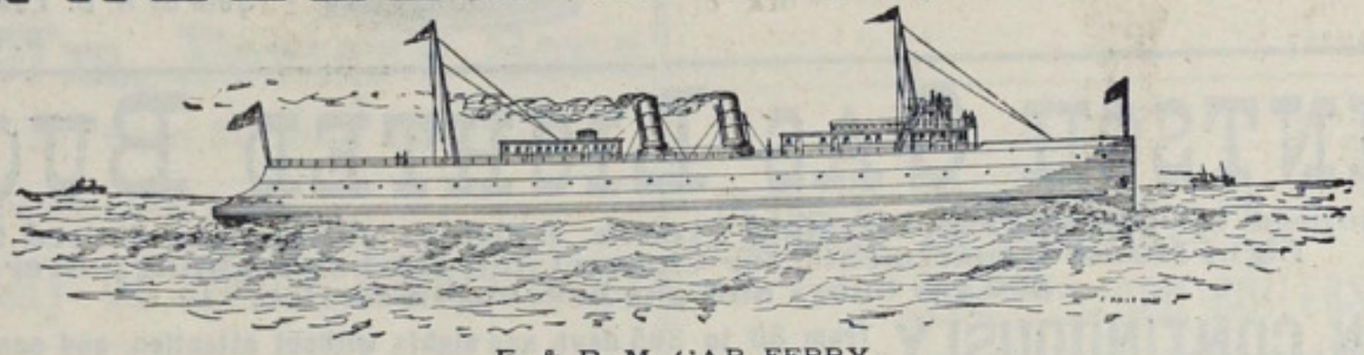

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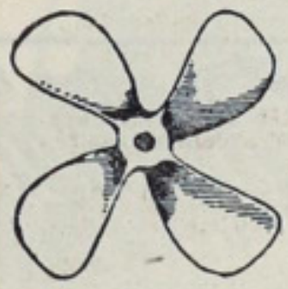

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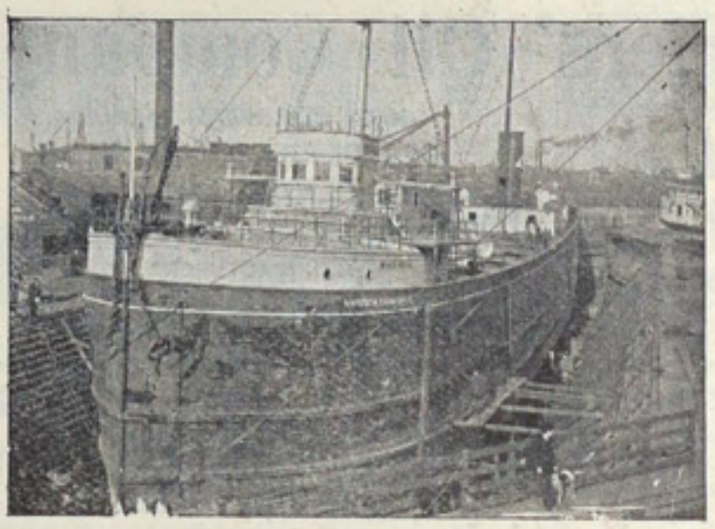

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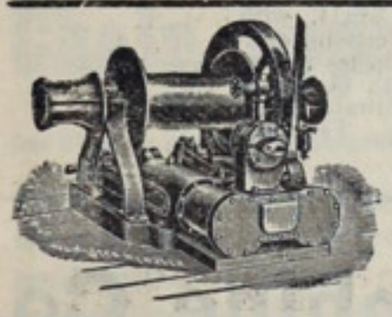

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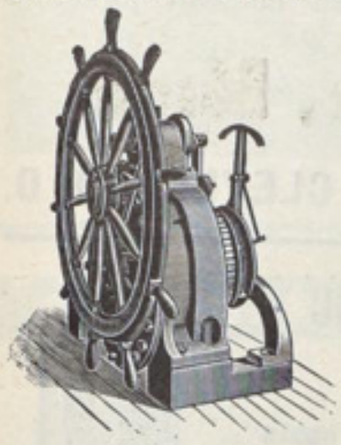

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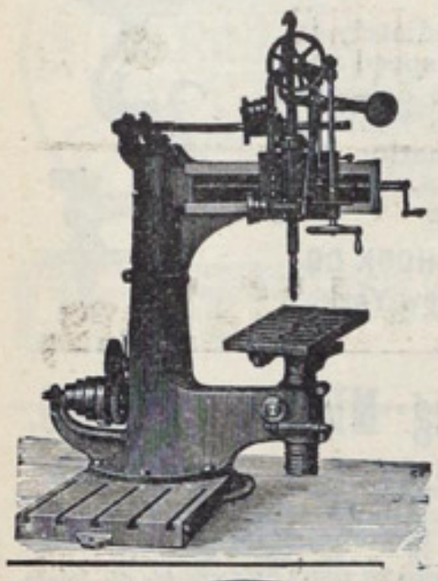

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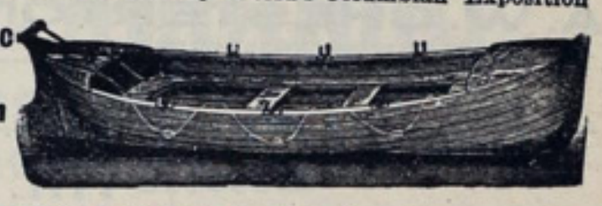

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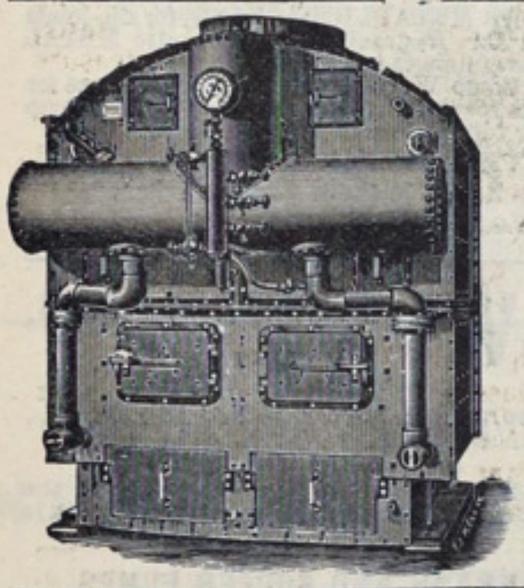

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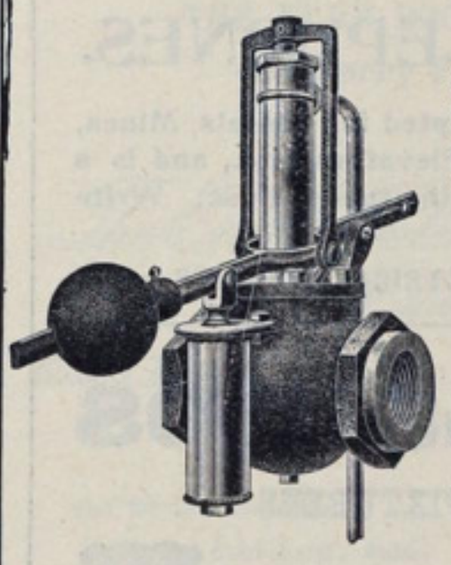

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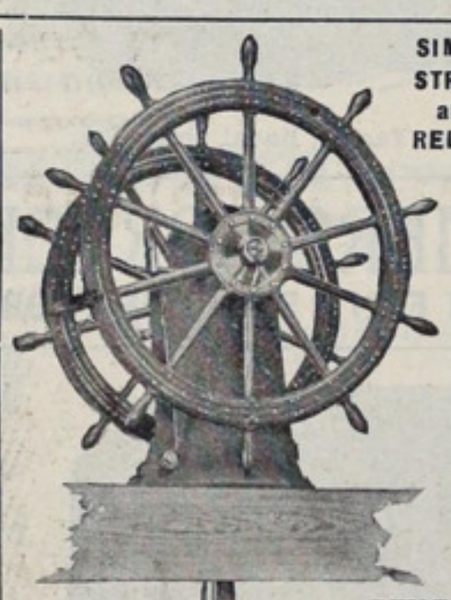

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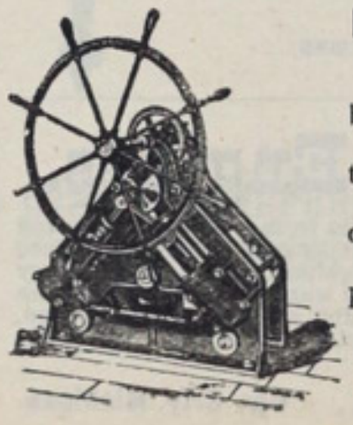

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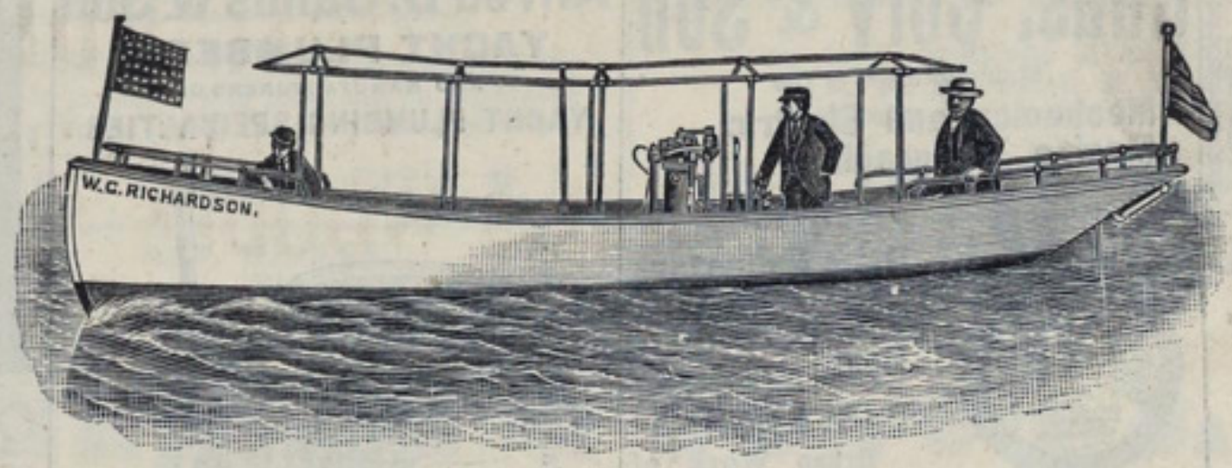

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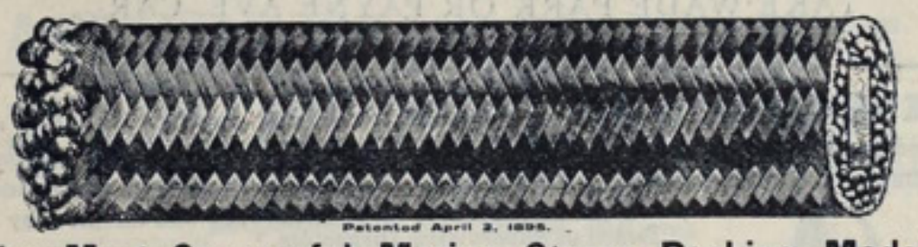

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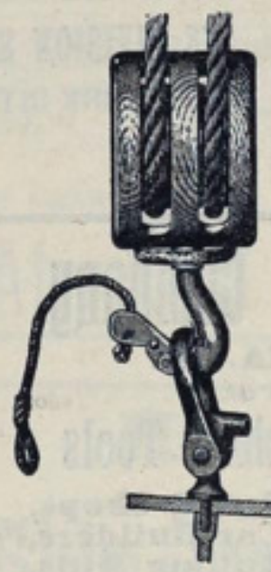

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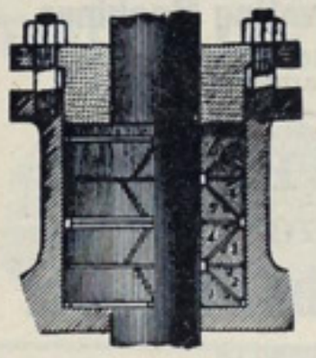

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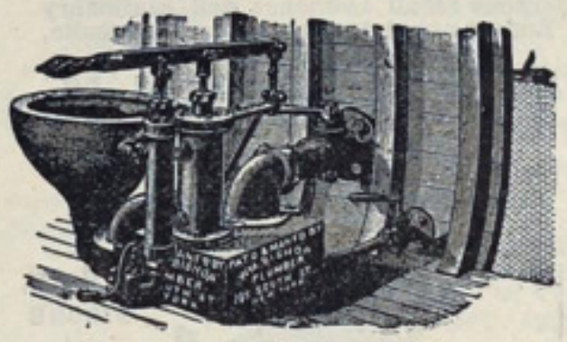

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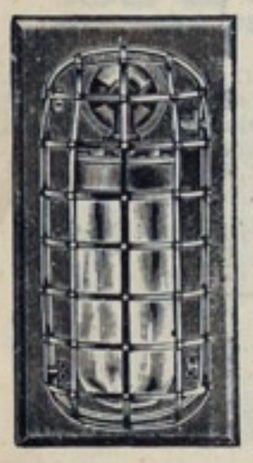

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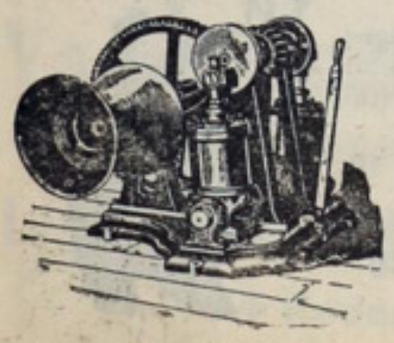

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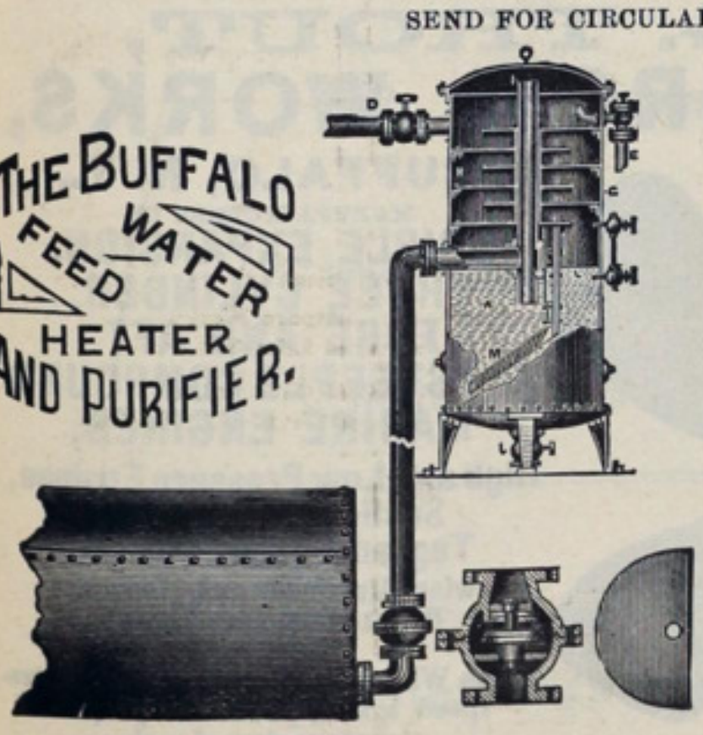

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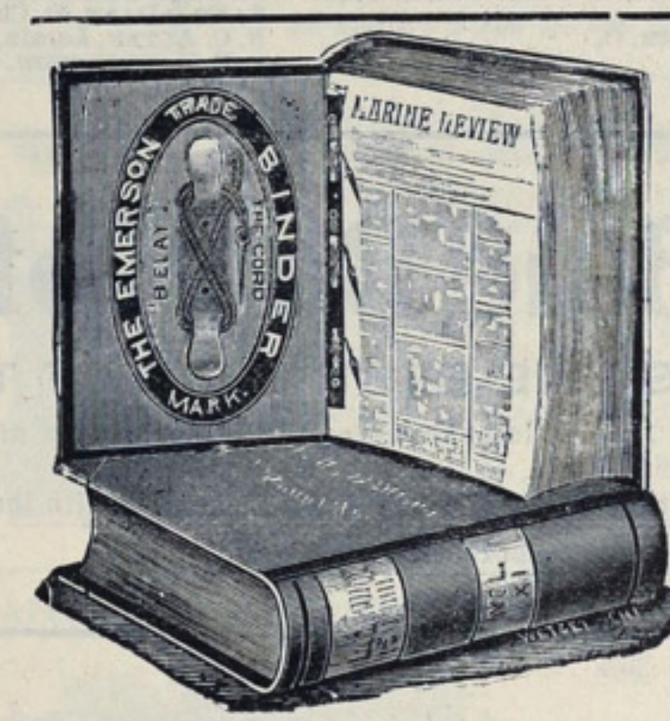

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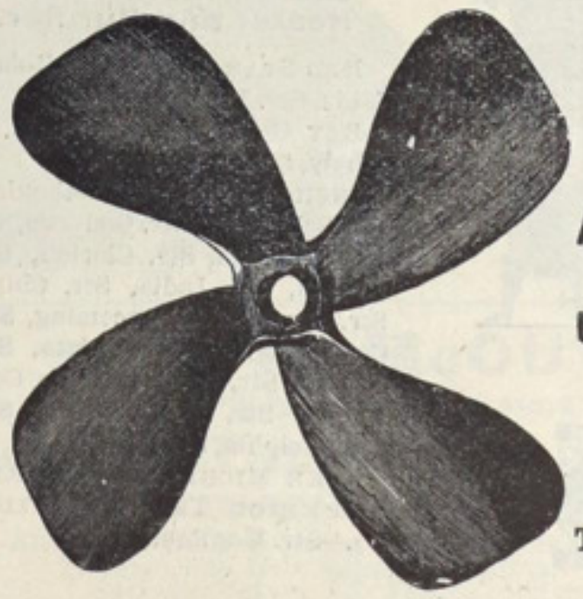

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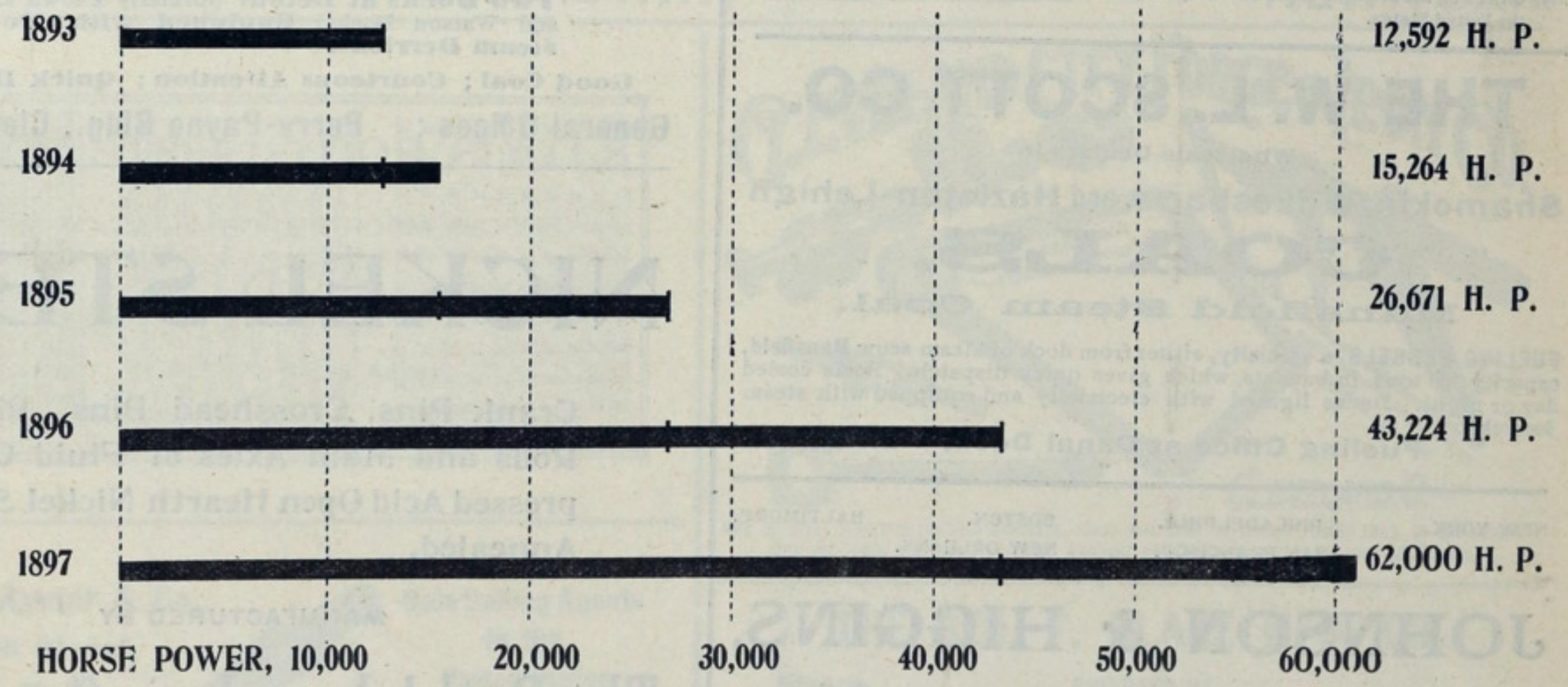

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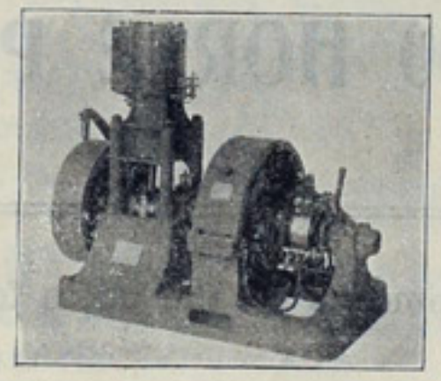

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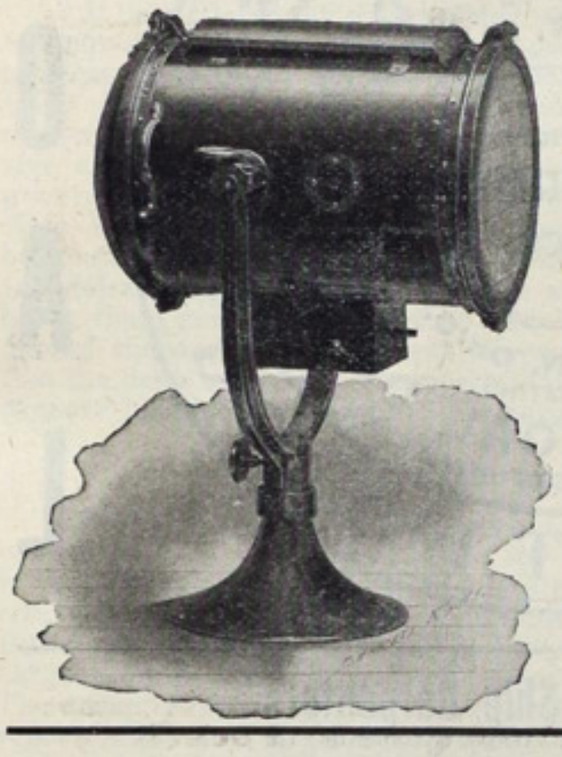

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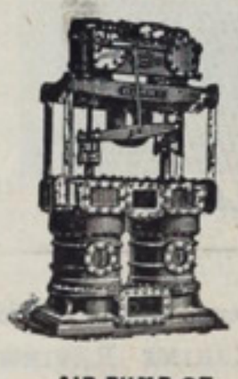

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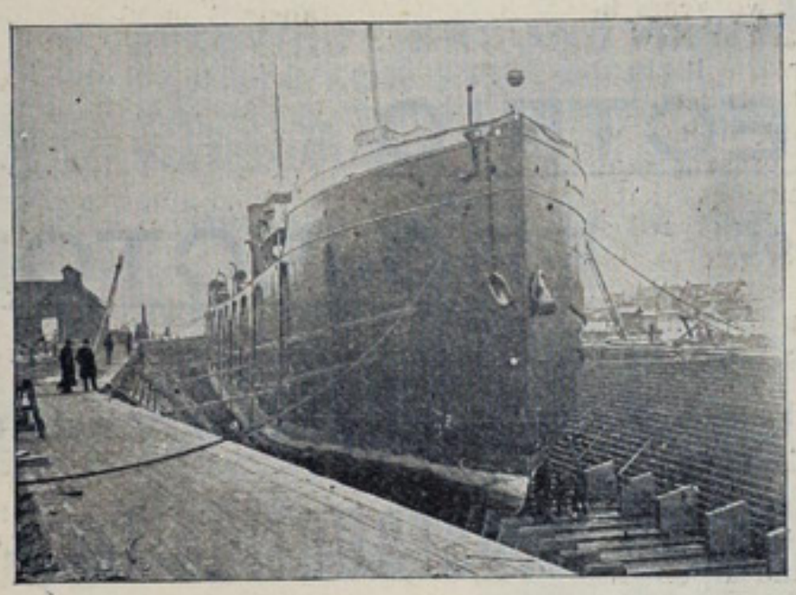

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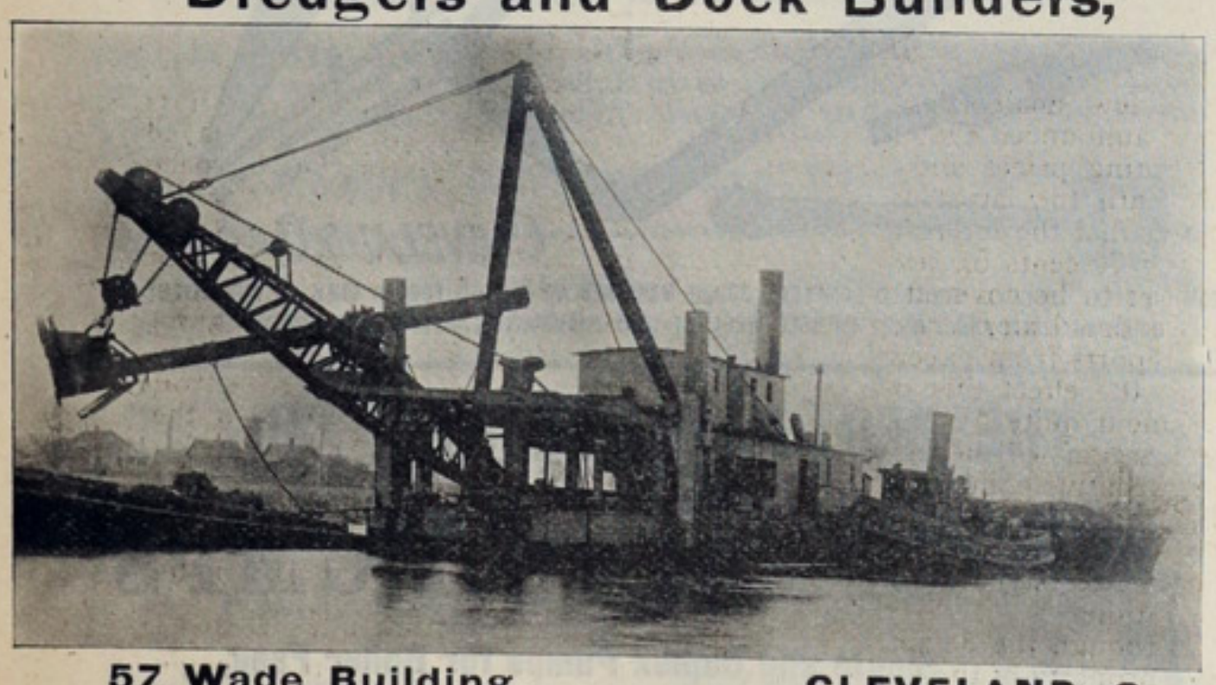

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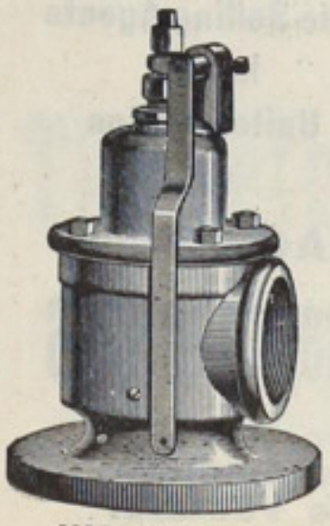

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